Meeting Date: **8/9/2016**

Report Type: Consent

Report ID: 2016-00749

City of SACRAMENTO 16

City Council Report
915 I Street, 1st Floor
www.CityofSacramento.org

Title: Contract: Shasta Park Water Facility (Published for 10-Day Review 07/28/2016)

Location: District 8

Recommendation: Pass a Resolution: 1) approving the contract plans and specifications for the Shasta Park 4MG Reservoir and Pump Station Project and awarding the contract to Sierra National Construction for an amount not-to-exceed $11,595,790; 2) authorizing the City Manager or the City Manager's designee to execute a construction management agreement with West Yost and Associates for an amount not-to-exceed $933,510; and 3) transferring $4.2 million from the Water Development Fees Fund's fund balance into Z14005400.

Contact: Dan Sherry, Engineering & Water Resources Manager, (916) 808-1419; Michelle Carrey, Supervising Engineer, (916) 808-1438; Marc Lee, Senior Engineer, (916) 808-7481, Department of Utilities

Presenter: None

Department: Department Of Utilities

Division: Cip Engineering

Dept ID: 14001321

Attachments:

1-Description/Analysis
2-Background
3-Location Map
4-Resolution
5-Contract
6-Agreement

City Attorney Review

Approved as to Form
Joe Robinson
7/21/2016 3:15:43 PM

Approvals/Acknowledgements

Department Director or Designee: Bill Busath - 7/15/2016 11:43:13 AM

Description/Analysis

Issue Detail: Staff recommends Council award a construction contract and approve a construction management agreement for the Shasta Park 4MG Reservoir and Pump Station Project (Z14005400, Project). This Project will construct a water facility that includes a 2,800 gallon per minute potable water well, groundwater treatment system, four million-gallon water storage reservoir, and a booster pump station.

Policy Considerations: The Project is consistent with both City and regional water planning efforts to provide a safe and reliable water supply.

Economic Impacts: This new infrastructure is expected to create 50.28 total jobs (28.91 direct jobs and 21.37 jobs through indirect and induced actives) and create $7,761,874.17 in total economic output ($4,892,368.62 of direct output and another $2,869,505.55 of output through indirect and induced activities).

The indicated economic impacts are estimates calculated using a calculation tool developed by the Center for Strategic Economic Research (CSER). CSER utilized the IMPLAN input-output model (2009 coefficients) to quantify the economic impacts of a hypothetical $1 million of spending in various construction categories within the City of Sacramento in an average one-year period. Actual impacts could differ significantly from the estimates and neither the City of Sacramento nor CSER shall be held responsible for consequences resulting from such differences.

Environmental Considerations: An Initial Study, Mitigated Negative Declaration, and a Mitigation Reporting Program were prepared for this Project in accordance with the California Environmental Quality Act (CEQA). The City Council adopted the Mitigated Negative Declaration and Mitigation Reporting Program on May 22, 2012 (Resolution No. 2012-138). No additional environmental review is required.

Sustainability Considerations: The Project has been reviewed for consistency with the goals, policies, and targets of the Sustainability Master Plan and the 2035 General Plan. The Project will advance these goals, policies, and targets by ensuring that the City continues to provide a safe, clean, and reliable water supply to its customers.

Committee/Commission Action: None.

Rationale for Recommendation: The Project was formally advertised on April 18, 2016, to solicit public bids. Nine bids were received and opened by the City Clerk on June 1, 2016 and are summarized below:

Contractor	Bid Amount
Sierra National Construction	$11,595,790
Canyon Springs Ent. DBA RSH Construction	$11,659,737
T&S Construction	$12,060,037
Gateway Pacific Contractors, Inc.	$12,576,160
Myers and Sons Construction LP	$12,898,000
Steve P. Rados, Inc.	$13,065,845
Mountain Cascade, Inc.	$13,322,346
Western Water Contractors, Inc.	$13,510,000
McGuire and Hester	$13,530,845

The lowest responsive and responsible bidder is Sierra National, with a bid amount of $11,595,790. The engineer's estimate was $12,640,000.

On May 14, 2014, a Request for Qualifications was issued for the construction management services for the Shasta Park project. On June 10, 2014, two firms, West Yost and Associates and Salaber Associates, Inc., submitted Statements of Qualifications. The qualifications for both firms were independently evaluated and ranked by a panel of DOU staff members. West Yost was the top-ranked firm.

Financial Considerations: The construction contract with Sierra National Construction has a not-to-exceed amount of $11,595,790 and the construction management agreement with West Yost and Associates has a not-to-exceed amount of $933,510. The total estimated remaining project cost including inspection, construction, and project management is estimated to be $13.4 million; current remaining budget is $9.4 million ($6.5 million of Water Development Fees Funds, $1.9 million of Water Funds, and $1 million of Water Grant/Reimbursable Funds). Staff estimates an additional $4.2 million is needed to complete the project and recommends transferring the amount from the Water Development Fees Fund's (Fund 6001) fund balance to the Project.

Local Business Enterprise (LBE): Sierra National is an LBE. West Yost Associates is an LBE.

Background

The 2005 Water Master Plan concluded that a finished water reservoir should be constructed in the southeast portion of Sacramento to help maintain service pressure through peak demand periods, and to provide additional emergency and fire suppression water supply. Providing a groundwater well at this location will allow the reservoir to be supplied with water without having to build a costly water main network to fill the reservoir.

The Shasta Park Reservoir Project (Project) includes the construction, operation and maintenance of an above-ground 4MG water reservoir, groundwater well, water treatment system, and pump station. The groundwater well will have a capacity of 2MG per day. On site water treatment will also have a capacity of 2MG per day, while the pump station would have a capacity of 15MG per day. The reservoir will be constructed of reinforced concrete or welded steel. Other site improvements will include a perimeter wall and landscaping.

The duties of the construction manager shall include but not be limited to resident engineer, inspection, materials testing and contract administration services.

Attachment 2

LOCATION MAP
CITY OF SACRAMENTO
SHASTA PARK RESERVOIR-PROPOSED
Z14005400

RESOLUTION NO. 2016-

Adopted by the Sacramento City Council

AWARDING CONSTRUCTION CONTRACT AND APPROVING CONSTRUCTION MANAGEMENT AGREEMENT FOR THE SHASTA PARK WATER FACILITY PROJECT AND APPROVING RELATED BUDGET TRANSFER

BACKGROUND

A. The 2005 Water Master Plan concluded that a finished water reservoir should be constructed in the southeast portion of Sacramento to help maintain service pressure through peak demand periods, and to provide additional emergency and fire suppression water supply.

B. On May 14, 2014, a Request for Qualifications was issued for construction management services to construct the Shasta Park Water Facility. West Yost was the top ranked firm. The construction contract was bid on April 18, 2016, and Sierra National Construction was the lowest responsible bidder.

C. A budget augmentation of $4.2 million is required to provide sufficient funds to complete the Shasta Park 4MG Reservoir and Pump Station Project (Z14005400).

BASED ON THE FACTS SET FORTH IN THE BACKGROUND, THE CITY COUNCIL RESOLVES AS FOLLOWS:

Section 1. The contract plans and specifications for the Shasta Park 4MG Reservoir and Pump Station Project are approved, and the contract is awarded to Sierra National Construction for an amount not-to-exceed $11,595,790.

Section 2. The City Manager or the City Manager's designee is authorized to sign a construction management agreement with West Yost and Associates for the Shasta Park 4MG Reservoir and Pump Station Project for an amount not-to-exceed $933,510.

Section 3. A transfer of $4.2 million from the Water Development Fees Fund's (Fund 6001) fund balance to Z14005400 is approved.

City of SACRAMENTO
Department of Utilities

ENGINEERING SERVICES DIVISON

CONTRACT SPECIFICATIONS
FOR

SHASTA PARK WATER FACILITY

PN: Z14005402

B16141321030

Engineer's Estimate: 12,640,000.00

Prebid Site Visit: Non-Mandatory Wednesday, April 27, 2016 at 10:00 AM
Location: at the terminal end of Kastanis Way, Sacramento, CA 95822

For Pre-Bid Information Call:	Separate Plans
Brett Ewart Senior Engineer (916) 808-1725	Bid to be received before 2:00 PM **May 26, 2016** City Hall, Office of the City Clerk 915 I Street, 5th Floor, Public Counter Sacramento, CA 95814

LBE PROGRAM PARTICIPATION

For information on meeting the City of Sacramento's Local Business Enterprise (LBE) project goals, please contact Procurement Services at (916) 808-6240, or visit the City of Sacramento's small business web site at: http://portal.cityofsacramento.org/Finance/Procurement/Bid-Information#bidding-options

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LBE INFORMATION

The City of Sacramento's Local Business Development program establishes an annual local business enterprise (LBE) participation goal for City contracts, and authorizes City departments to require minimum LBE participation levels in individual contracts. Under City Code section 3.60.270, all bidding contractors must meet or exceed the minimum LBE participation requirement specified in the contract's bid specifications to qualify as a responsive bidder.

For information on meeting the City of Sacramento's Local Business Enterprise (LBE) project goals, please contact Procurement Services at (916) 808-6240, or visit the City of Sacramento's small business web site at: http://portal.cityofsacramento.org/Finance/Procurement/Bid-Information#bidding-options

NOTICE TO CONTRACTORS

CITY OF SACRAMENTO

Sealed Proposals will be received by the City Clerk of the City of Sacramento at the Office of the City Clerk, City Hall, located at 915 I Street, 5th Floor, Public Counter, up to the hour of 2:00 p.m. on **May 26, 2016** and opened at and read after 2:00 p.m. on **May 26, 2016**, or as soon thereafter as business allows, in the Hearing Room, 2nd Floor Room, in Historic City Hall, for construction of:

SHASTA PARK WATER FACILITY
(PN: Z14005402) (B16141321030)

as set forth in the Contract Documents.

Proposals received and work performed thereunder shall comply with the requirements of Chapter 3.60 of the Sacramento City Code. Each Bid Proposal shall be accompanied by bid security of at least 10% of the sum the Bid Proposal. The City reserves the right to reject proposals or to waive any error or omission in any Bid Proposal received. Signed proposals shall be submitted on the printed forms contained herein and enclosed in an envelope marked:

SEALED PROPOSAL FOR
SHASTA PARK WATER FACILITY
(PN: Z14005402) (B16141321030)

You can view and download the plans and Contract Documents from:

PLANET BIDS
http://www.planetbids.com/portal/portal.cfm?CompanyID=15300#

The contractor and all subcontractors shall comply with the rates of wages currently established by the Director of Industrial Relations under provisions of Sections 1773 of the Labor Code of the State of California, a copy of which is on file in the office of the City Clerk and available to any interested party on request. In accordance with Sacramento City Code Section 3.60.180 and Section 1771.5 of the California Labor Code, the payment of the general prevailing rate of per diem wages or the general prevailing rate of per diem wages for holiday and overtime is not required for any construction project of $25,000 or less, or an alteration, demolition, repair, and maintenance project of $15,000 or less. The City of Sacramento has an approved Labor Compliance Program. **The City uses an electronic system for the submission of Labor Compliance Reports, which became effective May 1, 2007.** The contractor and every lower-tier subcontractor shall submit certified payrolls and labor compliance documentation electronically at the discretion of and in the manner specified by the City of Sacramento.

Electronic submittal is via a web-based system, accessed on the World Wide Web by a web browser. Each contractor and subcontractor is given a Log On identification and password to access the City of Sacramento's reporting system.

Use of the system may entail additional data entry of weekly payroll information including employee identification, labor classification, total hours worked and hours worked on this project, wage and benefit rates paid, etc.. The contractor's payroll and accounting software might be capable of generating a 'comma delimited file' that will interface with the software.

Department of Industrial Relations Registration and Reporting Requirements (SB 854)

Labor Code Section 1725.5 (enacted by SB 854) requires all contractors bidding on this contract, all subcontractors listed in a bid for this contract, and any contractor or subcontractor performing any work under this contract, to be currently registered with the California Department of Industrial Relations (DIR), as specified in Labor Code Section 1725.5. Labor Code Section 1771.1 (enacted by SB 854) provides that a contractor or subcontractor shall not be qualified to bid on, be listed in a bid proposal (subject to the requirements of Section 4104 of the Public Contract Code), or engage in the performance of any contract for public work, unless currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5. Every bidding contractor shall list the contractor's current DIR registration number, and the current DIR registration number of all listed subcontractors, on the Subcontractor and Local Business Enterprise (LBE) Participation Verification Form included in the contractor's bid.

Pursuant to Labor Code Section 1771.1(b): (1) any bid received from a contractor that is not currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5 **shall be rejected as non-responsive**; and (2) any bid listing one or more subcontractors on the bidder's Subcontractor and Local Business Enterprise (LBE) Participation Verification Form that are not currently registered and qualified to perform public work pursuant to Labor Code Section 1725.5, **shall be rejected as non-responsive**, unless the listing was an inadvertent error and any of the conditions specified in Labor Code Section 1771.1(c) apply.

This contract also is subject to compliance monitoring and enforcement by the DIR. For all contracts awarded on or after April 1, 2015, California Labor Code Section 1771.4 (enacted by SB 854) requires the contractor and all subcontractors to furnish electronic payroll records directly to the Labor Commissioner (in addition to City staff via the City's electronic system).

A Fact Sheet summarizing the provisions of SB 854 is attached. This is provided solely for informational purposes, and does not in any way affect the contractor's and subcontractors' obligation to comply in all respects with the provisions of SB 854, including the provisions referenced above, as well as all other applicable laws and regulations.

The contractor shall disseminate these provisions to every lower-tier subcontractor and vendor required to provide labor compliance documentation.

All questions regarding the City's Labor Compliance Program should be directed to the Department's contracts staff or the Labor Compliance Officer at (916) 808-4011.

Pursuant to Sacramento City Code Section 3.60.190, all contractors and subcontractors shall comply with Section 1777.5 et seq., of the California Labor Code governing the employment of apprentices. Pursuant to Sacramento City Code Section 3.60.250 and Public Contract Code Section 22300, any contract awarded pursuant to this invitation to bid shall contain a provision permitting the substitution of securities for monies withheld to ensure performance under the contract, in accordance with the requirements and form specified by the City.

Bid protests must be filled and maintained in accordance with the provisions of Sections 3.60.460 through 3.60.560 of the Sacramento City Code. Bid protests that do not comply with Sections 3.60.460 through 3.60.560 of the Sacramento City Code shall be invalid and shall not be considered. A bid protest fee of $750.00 is required at the time of filing. The term "bid protest" includes any bid protest that (1) claims that one or more bidders on this contract should be disqualified or rejected for any reason, (2) contests a City staff recommendation to award this contract to a particular bidder, or (3) contests a City staff recommendation to disqualify or reject one or more bidders on this contract. A copy of Sections 3.60.460 through 3.60.560 of the Sacramento City Code may be obtained from the Project Manager, or from the City Clerk, located at 915 I Street, 5th Floor, Sacramento, CA 95814.

The Project Manager's contact information is:

Brett Ewart, Department of Utilities, Engineering & Water Resource Division
1395 35th Avenue, Sacramento, CA 95822
Phone: (916) 808-1725 / Fax: (916) 808-1497/Email: BEwart@cityofsacramento.org

Proposition 84 Labor Compliance Program Requirements

This project is partially funded through The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Prop 84) funding, which is being administered by the California Department of Water Resources (DWR). All bidders, the Contractor awarded the Contract, and the Contractor's subcontractors and suppliers shall be required to comply with all applicable Prop 84 Requirements. Any bid that does not comply with all applicable Prop 84 Requirements may be rejected as nonresponsive.

The requirements applicable to the contract resulting from the Prop 84 Requirements are composed of but not limited to the following items:

(1) The contractor's duty to pay prevailing wages under Labor Code Section 1770 et seq., should the project exceed the exemption amounts. State prevailing wages are established by the Director of the California Department of Industrial Relations under the provisions of section 1773 of the California Labor Code. Copies of the of State prevailing wage rates are on file at **[City of Sacramento, Department of Utilities Address 1395 35th Avenue Sacrament, CA 95822]** and shall be made available to any bidder on request;
(2) The contractor's duty to employ registered apprentices on the public works project under Labor Code Section 1777.5;
(3) The requirement to keep and submit copies upon request of certified payroll records under Labor Code Section 1776, and penalties for failure to do so under Labor Code Section 1776(g);
(4) The prohibition against employment discrimination under Labor Code Section 1777.6; the Government Code, and Title VII of the Civil Rights Act of 1964;
(5) The prohibition against accepting or extracting kickback from employee wages under Labor Code Section 1778;
(6) The prohibition against accepting fees for registering any person for public work under Labor Code Section 1779; or for filling work orders on public works under Labor Code Section 1780;
(7) The requirement to list all subcontractors under Public Contracts Code Section 4104;
(8) The requirement to be properly licensed and to require all subcontractors to be properly licensed and the penalty for employing workers while unlicensed under Labor Code Section 1021 and under the California Contractors License Law, found at Business and Professions Code Section 7000 et seq;
(9) The prohibition against unfair competition under Business and Professions Code Sections 17200-17208;
(10) The requirement that the contractor be properly insured for Workers Compensation under Labor Code Section 1861;
(11) The requirement that the contractor abide by the Occupational, Safety and Health laws and regulations that apply to the particular construction project;
(12) The federal prohibition against hiring undocumented workers, and the requirement to secure proof of eligibility/citizenship from all workers;
(13) The requirement to provide itemized wage statements to employees under Labor Code Section 226.

In addition to the requirements resulting from the use of funds from Proposition 84, the following requirements apply resulting from the enactment of SB 854 (Stat. 2014, chapter 28):

- All contractors and subcontractors who bid or work on a public works project must register and pay an annual fee to DIR.

- No contractor or subcontractor may be listed on a bid proposal for a public works project (submitted on or after March 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)].
- No contractor or subcontractor may be awarded a contract for public work on a public works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5.
- This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

SHASTA PARK WATER FACILITY QUALIFICATION REQUIREMENTS

A. TANK CONTRACTOR

1. The Tank Contractor shall have constructed in its own name a minimum 5 AWWA D110, Type I tanks located within a region with a mapped spectral response acceleration, S_s, of 1.0g or greater in the past 10 years. At least 2 of the above tanks shall have been in successful service for a minimum of five years. Experience gained on work not meeting all of the technical requirements of this specification will not be considered for meeting the necessary experience requirements.

2. The Tank Contractor or Tank Contractor's listed Tank Prestressor shall be a specialist in the design and prestressing of prestressed concrete tanks using external circumferential strand wrapping and having at least 10 continuous years' experience in the construction of concrete structures which have been circumferentially prestressed.

3. The Tank Contractor or Tank Contractor's listed Tank Prestressor shall have successfully completed prestressing activities, as specified herein, on a minimum of 10 prestressed concrete tanks, greater than or equal to 2 million gallons in size, used for potable water storage in the last 10 years. At least 5 of the above tanks shall have been in successful service for a minimum of five years. Experience gained on work not meeting all of the technical requirements of this specification will not be considered for meeting the necessary experience requirements.

4. The superintendent for the Tank Contractor shall have successfully completed construction of a minimum of 3 tanks similar in design as specified and at least two tanks with 2 million gallons in size in the last 5 years. The qualifying construction superintendent shall have been in the direct employment of the qualified Tank Contractor and will be required to be on the project site in responsible charge full time, during all tank construction activities. Experience gained on work not meeting all of the technical requirements of this specification and not performed while in the employment of the Tank Contractor will not be considered for meeting the necessary experience requirements.

5. The Tank Prestressor shall have in its employ a professional design engineer who shall have designed a minimum of 5 prestressed tanks located within a region with a mapped spectral response acceleration, S_s, of 1.0g or greater. The Tank Prestressor shall also have in its employ an ACI 506 certified shotcrete foreman, prestressing foreman, each of whom shall have constructed a minimum of three AWWA D110, Type I tanks.

6. At the time of bid the qualified Tank Prestressor shall have a minimum of two operable strand wrapping and automated shotcrete machines meeting these requirements. Machines under construction shall not be considered in meeting the requirement of having two operable strand wrapping and automated shotcrete machines. Additionally, literature shall be submitted with the bid showing the proposed machinery with the recorders and a typical copy of an actual recording of the applied forces taken from one of the jobs on which such machinery has been used. Any stressing system that will not provide the substantial equivalent of the above requirements will be rejected.

7. Submittal Requirements

    a. Company history, contact person(s), address, and telephone number of Tank Contractor and Tank Prestressor.

b. Project references meeting the experience criteria described herein, listing reservoir owner, owner or engineer's contact person, address, telephone number, and year of completion.

c. The name, work history, and references of the superintendent to be assigned project responsibility by the Tank Contractor and meeting the experience requirements of this specification.

d. A description and detailed photographs of the proposed equipment to be used to meet the circumferential strand wrapped prestressing and vertical thread bar post-tensioning specifications herein, including the quality assurance measures of continuous force recording of the circumferential strand wrapping and the simultaneous force versus elongation of the vertical thread bar stressing.

B. WELDING

1. Welding shall be done by operators who have been qualified by tests as prescribed by AWS WI Sect. 7 to perform the type of work required. The quality of welding shall conform to AWS Code for Arc Welding in Building Construction Section 4, Workmanship.

C. STANDING SEAM METAL ROOF

1. Roofing shall be provided by a contractor regularly engaged in standing seam metal roofing installation for the last five years.

D. FLASHING AND SHEET METAL

1. Sheet metal fabricator shall have minimum 10 years' experience in fabrication of sheet metal items similar to items specified.

2. Sheet metal installer shall have minimum 5 years' experience installing sheet metal items specified.

E. FRP DOOR AND FRAMES

1. Company specializing in the manufacture of FRP doors and frames with a minimum of five years documented experience. All doors and frames shall manufactured by Tiger Door LLC, or approved equal.

F. GYPSUM DRYWALL CONSTRUCTION

1. Contractor shall have a minimum of 5 years' experience specializing in the installation of drywall.

G. COATING CONTRACTOR

1. The Coating Contractor shall hold a current painting license and have a minimum five years practical experience in the application of specified products to surfaces at similar facilities.

H. FILTER AND BACKWASH TANK COATING SYSTEM

1. The field coating activities under this Section shall require a C-33 painting and decorating license. The Contractor shall have a foreman with a minimum of 5 years of practical experience in the application of the specified coating products to surfaces at similar facilities on site at all times during any site preparation and coating activities under this Section.

I. ACRYLIC WATER REPELLENT

1. The Coating Contractor shall hold a current C-33 painting and decorating license and have a minimum 5 years practical experience in the application of specified products to surfaces at similar facilities.

J. ARCHITECTURAL PAINTING

1. The painting Contractor shall hold a current C-33 painting and decorating license and have a minimum 5 years practical experience in the application of specified products to surfaces at similar facilities.

K. VERTICAL TURBINE PUMPS (DEEP WELL, RAW WATER, BOOSTER PUMP STATION)

1. Equipment furnished under this Section shall be a single manufacture who has been regularly engaged in the design and manufacture of the equipment, and demonstrate that the quality is equal to equipment made by those manufacturers specifically named herein. The pump manufacturer shall have supplied complete units that have been in successful operation, at similar installations, for at least ten (10) years.

L. GASEOUS CHLORINE FEED SYSTEM

1. The gaseous chlorine feed and injection system integrator shall have a factory-trained service representative located in Northern California with in-house capability of servicing, repairing, and overhauling the equipment specified in this section. This service representative shall maintain a supply of spare parts for the equipment.

M. CHLORINE GAS CONTAINER CONTAINMENT SYSTEM

1. Equipment shall be the standard product in regular production by manufacturers of Chlorine gas container containment equipment and shall essentially duplicate equipment that has been in satisfactory operation at least five (5) installations for a period of at least five (5) years.

N. FLUORIDATION SYSTEM

1. All equipment shall be from single manufacturer who shall have Have experience, be reputable and qualified in designing and manufacturing packaged fluoride upflow saturator and feed system equipment of the size and type specified for a minimum of 5 years.

2. Have at least five identical self-contained fluoride upflow saturator and solution tank feed systems in operation for at least one year.

3. The manufacturer must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.

4. Self-contained fluoride upflow saturator and feed system shall be used as manufactured and supplied by Integrity Municipal Systems, LLC, Poway, CA, (858) 486-1620. Owner and Engineer are aware of no other supplier of a complete and self-contained shop assembled fluoride upflow saturator and feed system that is an equal to this specified manufacturer and product.

O. AIR STRIPPER SYSTEM

1. Contractor: Contractor shall have a minimum of 5 years of experience in the construction of water or wastewater treatment facilities.

2. Supplier: The Contractor shall assign to a single supplier full responsibility for the furnishing of the air stripping system. The designated single supplier, however, need not manufacture the entire system but shall coordinate the design, assembly, installation, and testing of the entire system as specified herein.

3. Manufacturer's Representative: Provide the services of a manufacturer's field representative who is experienced in the installation, adjustment, and operation of the equipment furnished and who has complete knowledge of the proper operation and maintenance of the system. Submit names and qualifications of each manufacturer's field representative and training engineer

with written certification from the manufacturer that each representative and trainer is technically qualified.

4. Welders (for steel aerator tanks only): Welding qualifications for welding procedures, welders, and welding operators shall be in accordance with Sections 8.2 and 8.8 of AWWA D100.

P. SIGNAL REPAIR

1. All work in connection with the traffic signal restoration and replacement including restoration of traffic detection loops shall be performed by experienced electrical contractor which has at least ten years' experience and whose record of experience and quality of work are satisfactory to the City and County. The Contractor must have previously constructed a minimum of three traffic signalizations. The Contractor shall hold a current C-10 state contracting license, and supply prior to beginning work proof of the license and a list of references of previously constructed projects.

Q. MANGANESE TREATMENT SYSTEM

1. The filter supplier shall be regularly engaged in providing horizontal pressure filters for manganese treatment for a minimum of 10 years.

2. The filter supplier shall provide a list of references based on five similar municipal potable water manganese treatment systems that have been completed within the last 10 years. Each references shall include a contact name, phone number, and address.

3. The filter supplier's trained field representative shall have overseen the installation and startup of not less than three pressure filter installations for MTS.

R. BACKWASH RECYCLE TANK

1. Demonstrate that the tank manufacturer has been regularly designing, fabricating and erecting similar steel tanks for at least 10 years.

S. ELECTRICAL SUBCONTRACTOR

1. It is the intent of this Division that the complete responsibility for management and installation of the electrical and instrumentation required for this project be by the Electrical Subcontractor. This responsibility includes, but not limited to, supervision and coordination of work performed by all suppliers of Division 16 and 17.

2. Uncertified electricians shall not perform electrical work for which certification is required per Labor Code Section 3099. Electricians shall be required to carry proof of certification on their person at all times. Electricians found on the jobsite without proof of certification will be asked to leave, prohibited from working on-site until proof of certification has been provided and may be reported to the Contractors State License Board (CSLB).

3. Contractor shall submit the proposed Electrical Subcontractor and System Supplier that will be used on this project.

4. If the Contractor, Electrical Subcontractor, and System Supplier listed in bid documents are deemed not qualified by Owner, they will have their bid rejected at the Owner's sole discretion and the next qualified bidder selected.

5. The Electrical Subcontractor shall meet the following minimum qualifications:

    a. Has a current C-10 Electrical Subcontractor's License.

    b. Has regularly engaged in similar electrical contracting for the Municipal Water and Wastewater Industry.

c. Has successfully performed work of similar or greater complexity on at least two previous projects under one company name and under the present company name.

d. Has all persons performing work as electricians certified by the California Apprenticeship Council per California Labor Code Section 3099.

e. Has been actively engaged in the type of electrical and instrumentation work specified in Division 16 for a minimum of two years.

6. Bid package shall include a list of five (5) completed projects of similar size and nature for water or wastewater treatment plants the Electrical Contractor has completed:

a. Provide completion dates of projects.

b. References of Owner Representative in charge of project, including contact name and telephone number.

T. SYSTEM SUPPLIER QUALIFICATIONS

1. It is the intent of this Division that complete responsibility in the supplying of the MCC/PLC, PLC programming and all instrumentation listed for Division 16 and other equipment required for this project be supplied by one System Supplier. This responsibility includes, but not limited to, all work necessary to select, furnish, program, supervise installation, calibrate, and place into operation all transmitters, instruments, controllers, alarm equipment, monitoring equipment, and accessories as specified herein.

2. The System Supplier shall have an on staff project engineer with prior experience on similar sized projects. This project engineer shall coordinate the technical aspects of this project and prepare the submittals and drawings. The system supplier project engineer shall attend all coordination meetings and be on-site when requested by the Owner's Engineer.

3. The list of approved Control Systems Integrators who are considered by the City as qualified to program the local PLC and SCADA system is listed in Section 17100.

4. Pre-Qualified System Suppliers

a. The Suppliers listed below have been determined to meet minimum qualifications specified in this Division and are pre-qualified by the Owner for providing supplier bids as system suppliers on the project.

1) Tesco (phone 916 395-8800).

2) Krug-Bixby-Long (KBL) (phone 510 887-1117).

3) MCC Control Systems (formerly Meyer Controls) (phone 707 449-0341).

b. Non-Pre-Qualified System Suppliers

1) System Suppliers not pre-qualified by the Owner shall submit the information listed herein at least 14 calendar days prior to bid date, and if approved by the Owner, will be listed in a Contract addendum prior to bid.

a) Company history.

b) List of five (5) completed projects of similar size and nature for water treatment plants.

c) Provide completion dates of projects.

d) References of Owner Representative in charge of project, including contact name and telephone number.

e) List of projects in progress.

f) Description of scope of projects.

g) Dollar amount of projects.

h) References of Owner Representative in charge of project, including contact name and telephone number.

i) Complete 2014 Year End Financial statement prepared by a Certified Accountant or complete 2014 Company Tax Returns listing assets and liabilities.

c. Factory test for this project shall be held within 150 miles of project location at the System Suppliers shop.

d. Additional information for clarification as requested by the Owner in writing shall be provided by the System Supplier asking for the qualification or qualification will automatically be denied.

e. System Supplier providing financial statements lacking detail or stating that detailed financial records are proprietary will be disqualified as a qualified System Supplier and is grounds alone for disqualification.

f. Any qualification package deemed incomplete or lacking sufficient information to determine qualification will result in System Supplier not being qualified.

g. No reason will be released on why a System Supplier was not qualified.

U. ICSC QUALIFICATIONS:

1. General:

a. It is the intent of this Division that complete responsibility in the supplying of the Switchboard/MCC/PLC, and all instrumentation in Division 17 and other equipment required for this project be supplied by one System Supplier (ICSC). This responsibility includes, but not limited to, all work necessary to select, furnish, program, supervise installation, calibrate, and place into operation all transmitters, instruments, controllers, alarm equipment, monitoring equipment, and accessories as specified herein.

b. The ICSC shall have an on staff project engineer with prior experience on similar sized projects. This project engineer shall coordinate the technical aspects of this project and prepare the submittals and drawings. The system supplier project engineer shall attend all coordination meetings and be on-site when requested by the Owner's Engineer.

c. The list of approved Control Systems Integrators who are considered by the City as qualified to program the local PLC and SCADA system is listed in Section 17100.

2. Pre-Qualified ICSC

a. The Suppliers listed below have been determined to meet minimum qualifications specified in this Division and are pre-qualified by the Owner for providing supplier bids as system suppliers on the project.

1) Krug-Bixby-Long (KBL) (phone 510 887-1117).

2) Tesco (phone 916 395-8800).

3) MCC Control Systems (formerly Meyer Controls) (phone 707 449-0341).

3. Non-Pre-Qualified ICSC

a. ICSC not pre-qualified by the Owner shall submit the information listed herein at least 14 calendar days prior to bid date, and if approved by the Owner, will be listed in a Contract addendum prior to bid.

1) Document that the ICSC company has been actively involved in the instrumentation, PLC based control systems, and SCADA systems business for a minimum of five years and has adequate facilities, organization structure, manpower and technical and managerial expertise to properly perform the Work as specified in these Specifications.

2) Submit a financial prospectus indicative of the corporation's financial state. This prospectus shall also include:

a) A letter from a financial institution indicating a current line of credit and bonding limit which can be applied to this Project.

b) Latest annual report or reviewed financial statement.

3) Document that the ICSC has a qualified permanent service facility:

a) Said facility shall be staffed with permanent employees and equipped with the tools and test equipment necessary to calibrate, test, and start-up all of the instrumentation, control, telemetry, and SCADA systems hardware and software furnished under this Contract, including remote diagnostic capability.

b) Document in-house resource of permanent personnel experienced in the design and programming of equipment and systems as specified in these Specifications.

c) Document the existence of a training program staffed by qualified instructors, to provide proper training in the operation and maintenance of equipment as specified in these Specifications.

d) Document that the firm is a recognized or certified “system integrator partner” or similar designation for the SCADA software and PLC system being supplied for this Project.

e) Service facility for the factory test shall be held within 150 miles of the project location at the ICSC company’s service facility.

4) Similar project experience of the company:

a) Provide a list of at least 5 successfully completed projects for a water and/or wastewater system of similar scope and complexity in which the proposing firm used components the same as those intended for use on this Project. The proposing firm must have performed, for each listed project, system engineering, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), software configuration and documentation, field testing,

calibration and start-up, operator instruction and maintenance training. In addition, provide the following information for each project:

5) Name of plant or system owner, contact name, and current telephone number. Design engineer's name, address, and telephone number. Failure to provide current contact information may result in the listed project being disqualified for use in meeting the minimum requirements for prequalification.

6) Manufacturer and model number(s) of the PLC based control system and the computer-based SCADA system used for both hardware and software.

7) Brief description of the system.

8) Approximate number of input and output signals: analog, digital, and fieldbus.

9) Brief application software description.

10) Contracted cost of the system, separate by base amount and any change orders for the completed projects.

11) Duration of the project and date of completion.

12) Information on the proposed Project team members:

    a) Provide the name and resume of the individual persons who will be responsible for each of the following:

13) Office engineering and management of this Project.

14) Lead for software configuration/programming.

15) Individual who will be responsible for the hardware and hardware interface design.

16) Individual who will be responsible for field testing, calibration, and start-up.

17) Individuals who will be responsible for operator training.

    a) All of these individuals shall be permanent employees of the proposing firm.

18) Additional information for clarification as requested by the Owner in writing shall be provided by the ICSC asking for the qualification or qualification will automatically be denied.

19) Determination of the proposed ICSC qualifications is at the sole discretion of the ENGINEER. Any qualification package deemed incomplete or lacking sufficient information to determine qualification will result in ICSC not being qualified. No reason will be released on why an ICSC was not qualified.

V. DIESEL GENERATOR SUPPLIER

1. Diesel generator equipment supplier shall be a California firm carrying supply of repair parts in the State.

2. The supplier shall have represented both the engine and generator manufacturers for at least three years prior to the bid award.

THE FOLLOWING DOCUMENTS

ARE TO BE COMPLETED AND

SUBMITTED WITH THE BID PACKAGE

Contractor's Name: **Sierra National Construction, Inc.**
(Please print)

CITY OF SACRAMENTO

SEALED PROPOSAL

(MUST BE SIGNED BY BIDDER)

The Sealed Proposal will be received not later than **June 1, 2016**, at the Office of the City Clerk, New City Hall, at 915 I Street, 5th Floor, Public Counter, Sacramento, California and opened at 2:00 PM, or as soon thereafter as business allows, on **June 1, 2016**, by the Office of the City Clerk, 915 I Street, Historic City Hall, 2nd Floor, Hearing Room, Sacramento, California.

TO THE HONORABLE CITY COUNCIL:

The undersigned hereby proposes and agrees to furnish any and all required labor, material, transportation, and services for

SHASTA PARK WATER FACILITY
(PN: Z14005402) (B16141321030)

in the City and County of Sacramento, California.

TOTAL BID: eleven million five hundred ninety five thous. ($11,595,790).
Seven hundred ninety Dollars

The work herein described is to be performed in strict conformity with the Plans, City of Sacramento Standard Specifications (Resolution No. 89-216) and these Special Provisions, all as on file in the Office of the City Clerk, at the following unit prices.

Item No.	Description	Estimated Quantity	Unit	Total
1	Mobilization **(6% or less of total bid)**	1	LS	$544,000
2	Trench Sheeting, Shoring and Bracing	1	LS	$6,500
3	Potable Water Well	1	LS	$210,500
4	Groundwater Treatment Systems	1	LS	$1,855,000
5	Concrete Water Storage Tank	1	LS	$2,950,000
5A	Concrete Water Storage Tank Prestressing **(Performed by DN Tanks)**	1	LS	$ **736,845.00**
6	Booster Pump Station	1	LS	$796,000
7	CMU Control Building	1	LS	$560,000
8	Electrical and Plant Controls	1	LS	$2,400,000
9	Landscaping and Irrigation	1	LS	$91,500
10	Wrought Iron Fence and Gates	1	LS	$183,945
11	24-Inch Diameter Water Transmission Main	1	LS	$400,000
12	6-Inch Diameter Sewer Main	1	LS	$16,500
13	All other Work for Completion of the Shasta Park Water Facility	1	LS	$845,000

TOTAL BID: $11,595,790

Contractor's Name: _____
(Please print)

CITY OF SACRAMENTO

SEALED PROPOSAL

(MUST BE SIGNED BY BIDDER)

The Sealed Proposal will be received not later than **May 26, 2016**, at the Office of the City Clerk, New City Hall, at 915 I Street, 5th Floor, Public Counter, Sacramento, California and opened at 2:00 PM, or as soon thereafter as business allows, on **May 26, 2016**, by the Office of the City Clerk, 915 I Street, Historic City Hall, 2nd Floor, Hearing Room, Sacramento, California.

TO THE HONORABLE CITY COUNCIL:

The undersigned hereby proposes and agrees to furnish any and all required labor, material, transportation, and services for

SHASTA PARK WATER FACILITY
(PN: Z14005402) (B16141321030)

in the City and County of Sacramento, California.

TOTAL BID: _____ ($_____).

The work herein described is to be performed in strict conformity with the Plans, City of Sacramento Standard Specifications (Resolution No. 89-216) and these Special Provisions, all as on file in the Office of the City Clerk, at the following unit prices.

Item No.	Description	Estimated Quantity	Unit	Total
1	Mobilization **(6% or less of total bid)**	1	LS	$_____
2	Trench Sheeting, Shoring and Bracing	1	LS	$_____
3	Potable Water Well	1	LS	$_____
4	Groundwater Treatment Systems	1	LS	$_____
5	Concrete Water Storage Tank	1	LS	$_____
5A	Concrete Water Storage Tank Prestressing **(Performed by DN Tanks)**	1	LS	$ **736,845.00**
6	Booster Pump Station	1	LS	$_____
7	CMU Control Building	1	LS	$_____
8	Electrical and Plant Controls	1	LS	$_____
9	Landscaping and Irrigation	1	LS	$_____
10	Wrought Iron Fence and Gates	1	LS	$_____
11	24-Inch Diameter Water Transmission Main	1	LS	$_____
12	6-Inch Diameter Sewer Main	1	LS	$_____
13	All other Work for Completion of the Shasta Park Water Facility	1	LS	$_____

TOTAL BID: $_____

The undersigned agrees to execute the Agreement and provide City the executed Agreement, the required insurance certificates, endorsements, and waivers of subrogation, and the required surety bonds within ten (10) calendar days after the undersigned's receipt of the City's notice that the undersigned will be recommended for Contract award and prior to award of the Contract by the City Council.

In determining the amount bid by each bidder, City shall disregard mathematical errors in addition, subtraction, multiplication and division that appear obvious on the face of the Proposal. When such a mathematical error appears on the Proposal, the City shall have the right to correct such error and to compute the total amount bid by said bidder on the basis of the corrected figure or figures.

When the unit price of an item is required to be set forth in the Proposal, and the total for the item set forth separately does not agree with a figure derived by multiplying the item unit price times the Engineer's estimate of the quantity of work to be performed for said item, the item unit price shall prevail over the sum set forth as the total for the item unless, in the sole discretion of the City, such a procedure would be inconsistent with the policy of the City's bidding procedures. The total paid for each such item of work shall be based upon the item unit price and not the total price.

Should the Proposal contain only a total price for an item and the item unit price is omitted, the City shall determine the item unit price by dividing the total price of the item by the Engineer's estimate of the quantity of work to be performed for the item of work.

If the Proposal contains neither the item price nor the total price for the item, then it shall be deemed incomplete and the Proposal shall be disregarded.

It is understood that this bid is based upon completion of the work within a period **of three hundred fifty (350) working days** commencing on the date specified in the Notice to Proceed.

The amount of liquidated damages to be paid by the Contractor for failure to complete the work by the completion date (as extended, if applicable) shall be **one thousand five hundred ($1,500.00) for each calendar day**, continuing to the time at which the work is completed. Such amount is the actual cash value agreed upon as the loss to the City resulting from the default of the Contractor.

The undersigned represents and warrants that he/she has examined the location of the proposed work and is familiar with the conditions at the place where the work is to be done. The undersigned further represents that he/she has reviewed and understands the Plans, Special Provisions, and other contract documents, and the undersigned is satisfied with all conditions for the performance of the work.

Please note that information included in the above documentation and/or obtained from such other owner agency or municipality or from another source regarding the bidder's performance on another public project also may be used by the City in determining whether the bidder is a responsible bidder.

The undersigned has carefully checked all of the above figures and understands that the City of Sacramento will not be responsible for any errors or omissions on the part of the undersigned in making up this bid.

This proposal shall not be withdrawn for the time periods specified in Section 3-2 of the City of Sacramento Standard Specifications for award of contract to respective low bidders. This proposal is submitted in accordance with Chapter 3.60 of the Sacramento City Code and Sections 1, 2, and 3 of the City of Sacramento Standard Specifications.

In accordance with Standard Specification Section 3-2, the City shall award this contract to the lowest responsible bidder, if such award is made, within forty-five (45) working days after opening of the Proposals. The City reserves the right to reject any and all bids.

BID DEPOSIT ENCLOSED IN THE FOLLOWING FORM:

$_____not less than ten (10) percent of amount bid.

_____CERTIFIED CHECK

_____MONEY ORDER

_____CASHIERS'S CHECK

_____BID BOND

FOR CITY USE ONLY

TYPE OF DEPOSIT

- ☐ Bid Bond
- ☐ Cashier/Certified Check
- ☐ Other_____

Reviewer's Initials: _____

CONTRACTOR

Addendum No. 1 _____ _____

Addendum No. 2 _____ By:_____
(Signature)

Addendum No. 3 _____ Title:_____

Addendum No. 4 _____ Address:_____
No PO Box – Physical Address ONLY

_____
City STATE ZIIP Code

Telephone No. _____

Fax No. _____

Email _____

(Federal Tax ID # or Social Security #)
Under penalty of perjury, I certify that the Taxpayer Identification Number and all other information provided here are correct.

_____

DIR Registration Number: _____

Valid Contractor's License No. _____, Classification _____ is held by the bidder.

Expiration date _____. Representation made herein are true and correct under penalty or perjury

PN: Z14005402 (B16141321030)

KNOW ALL MEN BY THESE PRESENTS,

That we, _____

as Principal, and _____

a corporation duly organized under the laws of the State of _____and duly licensed to become sole surety on bonds required or authorized by the State of California, as Surety, are held and firmly bound unto the City of Sacramento, hereinafter called the City, in the penal sum of ten percent (10%) of the (BASE OR LUMP SUM) Proposal of the Principal above named, or other amount as set forth in the Invitation to Bidders, submitted by said Principal to the City for the Work described below, for the payment of which sum in lawful money of the United States, well and truly to be made, we bind ourselves, our heirs, executors, administrators and successors, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH

That whereas the Principal has submitted the above mentioned proposal to the City, for which Proposals are to be opened by the Office of the City Clerk, Historic City Hall, Hearing Room, 2nd Floor, 915 I Street, Sacramento, California, on **May 26, 2016**, for the Work specifically described as follows:

SHASTA PARK WATER FACILITY
(PN: Z14005402) (B16141321030)

NOW, THEREFORE, if the aforesaid Principal is award the Agreement and within the time and manner required under the Contract Documents, enters into a written Agreement, in the prescribed form, in accordance with the Proposal, and files two (2) bonds with the City, one to guarantee faithful performance and the other to guarantee payment for labor and materials, and files the required insurance policies with the City, all as required by the Contract Documents or by law, then the obligation shall be null and void; otherwise it shall be and remain in full force and effect.

In the event suit is brought upon this bond by the Obligee and judgment is recovered, the Surety shall pay all costs incurred by the Obligee in such suit, including a reasonable attorney's fee to be fixed by the court, which sums shall be additional to the principal amount of this bond.

IN WITNESS THEREOF, We have hereunto set our hands and seal this _____day of _____, 2016.

_____
PRINCIPAL Seal

By: _____

_____
Title

_____
SURETY Seal

By _____

_____
Title

_____
Agent Name and Address

_____

_____
Agent Phone #

_____
Surety Phone #

_____
California License #

City of SACRAMENTO

Subcontractor and Local Business Enterprise Participation Form
For Public Projects over $100,000 (use only base bid amount to estimate dollar value)
THIS FORM MUST BE SUBMITTED WITH THE SEALED BID PROPOSAL

To be eligible for award of this contract, the bidder shall list the business entities used to attain the 5% LBE requirement. Additionally, the bidder shall list all other subcontractors who perform work, render service, or provide materials in an amount in excess of one-half of 1 percent of the total bid amount. In the case of bids for the construction of streets and highways, including bridges, subcontractors whose subcontract value exceeds one-half of 1 percent of the total bid or ten thousand dollars ($10,000), whichever is greater, shall be listed. Estimated dollar values shall be provided for all work / services listed. The failure to attain the 5% LBE participation or the inclusion of false information or the omission of required information will render the bid non-responsive.

Prime Contractor Name		**Date**	
Prime Contractor Address		**Bid Amount**	$
(REQUIRED) Prime Contractor DIR Registration #		**Is Prime LBE?**	Yes No

Business Name		**Subcontractor DIR Registration # (subject to verification)**	**LBE?**	**Type of Work, Services, or Supplies to be provided to complete contract**	**Estimated Dollar Value of Work, Services or Supplies to be Performed of Provided**
License Number					
Address			Yes		$
City, State, Zip			No		
Contact Person					
Phone					
Business Name		**Subcontractor DIR Registration # (subject to verification)**	**LBE?**	**Type of Work, Services, or Supplies to be provided to complete contract**	**Estimated Dollar Value of Work, Services or Supplies to be Performed of Provided**
License Number					
Address			Yes		$
City, State, Zip			No		
Contact Person					
Phone					
Business Name		**Subcontractor DIR Registration # (subject to verification)**	**LBE?**	**Type of Work, Services, or Supplies to be provided to complete contract**	**Estimated Dollar Value of Work, Services or Supplies to be Performed of Provided**
License Number					
Address			Yes		$
City, State, Zip			No		
Contact Person					
Phone					

COPY AND ATTACH ADDITIONAL SHEETS AS NECESSARY

I hereby certify that each subcontractor listed on this Subcontractor and LBE Participation Form has been notified that it has been listed and has consented in writing to its name being submitted for this contract. The Prime Contractor also certifies that it will notify each subcontractor listed on this Form in writing if the contract award is made to the Prime Contractor, and will make all documentation relevant to the subcontractor and LBE participation available to City of Sacramento upon request. The Prime Contractor further certifies that all of the information contained in this Form is true and correct and acknowledges that the City will rely on the accuracy of this information in awarding the contract.

PRINCIPAL OF FIRM:

Signature	**Title**	**Date**

Form Revised 3/9/15

DRUG-FREE WORKPLACE POLICY AND AFFIDAVIT

BID MAY BE DECLARED NONRESPONSIVE IF THIS FORM (COMPLETED) IS NOT ATTACHED.
Pursuant to City Council Resolution CC90-498 dated 6/26/90 the following is required.

The undersigned contractor certifies that it and all subcontractors performing under this contract will provide a drug-free workplace by:

1. Publishing a "Drug-Free Workplace" statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition.

2. Establishing a Drug-Free Awareness Program to inform employees about:

   a. The dangers of drug abuse in the workplace.
   b. The contractor's policy of maintaining a drug-free workplace.
   c. Any available drug counseling, rehabilitation, and employee assistance program.
   d. The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.

3. Notify employees that as a condition of employment under this contract, employees will be expected to:

   a. Abide by the terms of the statement.
   b. Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace.

4. Making it a requirement that each employee to be engaged in the performance of the contract be given a copy on the "Drug-Free Workplace" statement.

5. Taking one of the following appropriate actions, within thirty (30) days of receiving notice from an employee or otherwise receiving such notice, that said employee has received a drug conviction for a violation occurring in the workplace:

   a. Taking appropriate disciplinary action against such an employee, up to and including termination; or
   b. Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, state, or local health, law enforcement or other appropriate agency.

* I certify that no person employed by this company, corporation, or business has been convicted of any criminal drug statute violation on any job site or project where this company, corporation, or business was performing work within three years of the date of my signature below.

EXCEPTION:

_____

Date | Violation Type | Place of Occurrence

If additional space is required use back of this form.

*The above statement will also be incorporated as a part of each subcontract agreement for any and all subcontractors selected for performance on this project.

IN THE EVENT THIS COMPANY, CORPORATION, OR BUSINESS IS AWARDED THIS CONSTRUCTION CONTRACT, AS A RESULT OF THIS BID; THE CONTRACTOR WITH HIS/HER SIGNATURE REPRESENTS TO THE CITY THAT THE INFORMATION DISCLOSED IN THIS DOCUMENT IS COMPLETE AND ACCURATE. IT IS UNDERSTOOD AND AGREED THAT FALSE CERTIFICATION IS SUBJECT TO IMMEDIATE TERMINATION BY THE CITY.

The Representations Made Herein On This Document Are Made Under Penalty Of Perjury.

CONTRACTOR'S NAME:_____

BY:_____Date:_____

Signature | Title

Effects of violations: a. Suspension of payments under this contract. b. Suspension or termination of the contract. c. Suspension or debarment of the contractor from receiving any contract from the City of Sacramento for a period not to exceed five years.
FM 681 7/10/9

MINIMUM QUALIFICATIONS QUESTIONNAIRE

Sacramento City Code Section 3.60.020 authorizes the Sacramento City Council to adopt standard minimum qualifications for bidders on competitively bid public works construction projects, and requires, among other provisions, that a bidder meet such minimum qualifications at the time of bid opening in order to bid. On July 31, 2007, the City Council adopted Resolution No. 2007-574 establishing these standard minimum qualifications. Pursuant to City Code section 3.60.020, a bidder failing to meet these minimum qualifications at the time of bid opening shall not be considered a responsible bidder for purposes of bidding on the subject project.

All bidders must demonstrate compliance with the minimum qualifications established by Resolution No. 2007-574 by completing all of the questions contained in this questionnaire. Bidder responses shall be limited to those operating business units, offices, branches and/or subsidiary divisions of the bidder that will be involved with the performance of any project work if awarded the contract. If a bidder answers "yes" to any single question, fails to submit a fully completed questionnaire, or submits false information, this will result in a determination that the minimum qualifications are not met, and the bidder shall not be considered a qualified bidder for purposes of bidding on this contract. If two or more entities submit a bid on a contract as a Joint Venture, each entity within the Joint Venture must separately meet these minimum qualifications for the Joint Venture to be considered a qualified bidder.

The City of Sacramento ("City") shall make its determination on the basis of the submitted questionnaire, as well as any relevant information that is obtained from others or as a result of investigation by the City. While it is the intent of this questionnaire to assist the City in determining whether bidders possess the minimum qualifications necessary to submit bids on the City's competitively bid public works construction contracts, the fact that a bidder submits a questionnaire demonstrating that it meets these minimum qualifications shall not in any way limit or affect the City's ability to: (1) review other information contained in the bid submitted by the bidder, and additional relevant information, and determine whether the contractor is a responsive and/or responsible bidder; or (2) establish pre-qualification requirements for a specific contract or contracts.

By submitting this questionnaire, the bidder consents to the disclosure of its questionnaire answers: (i) to third parties for purposes of verification and investigation; (ii) in connection with any protest, challenge or appeal of any action taken by the City; and (iii) as required by any law or regulation, including without limitation the California Public Records Act (Calif. Gov't Code sections 6250 et seq.). Each questionnaire must be signed under penalty of perjury in the manner designated at the end of the form, by an individual who has the legal authority to bind the bidder submitting the questionnaire. If any information provided by a bidder becomes inaccurate, the bidder shall immediately notify the City and provide updated accurate information in writing, under penalty of perjury.

QUESTIONNAIRE

NOTICE: **For firms that maintain other operating business units, offices, branches and/or subsidiary divisions that will not be involved with the performance of any project work if the firm is awarded the contract, references hereafter to "your firm" shall mean only those operating business units, offices, branches and/or subsidiary divisions that will be involved with the performance of any project work.**

All of the following questions regarding "your firm" refer to the firm (corporation, partnership or sole proprietor) submitting this questionnaire, as well as any firm(s) with which any of your firm's owners, officers, or partners are or have been associated as an owner, officer, partner or similar position within the last five years

The firm submitting this questionnaire shall not be considered a responsible bidder if the answer to any of these questions is "yes", or if the firm submits a questionnaire that is not fully completed or contains false information.

1. **Classification & Expiration Date(s) of California** Contractor's License Number(s) held by firm:

   _____

2. Has a contractor's license held by your firm and/or any owner, officer or partner of your firm been revoked at anytime in the last five years?

   ☐ Yes ☐ No

3. Within the last five years, has a surety firm completed a contract on your firm's behalf, or paid for completion of a contract to which your firm was a party, because your firm was considered to be in default or was terminated for cause by the project owner?

   ☐ Yes ☐ No

4. At the time of submitting this minimum qualifications questionnaire, is your firm ineligible to bid on or be awarded a public works contract, or perform as a subcontractor on a public works contract, pursuant to either California Labor Code section 1777.1 (prevailing wage violations) or Labor Code section 1777.7 (apprenticeship violations)?

   ☐ Yes ☐ No

5. At any time during the last five years, has your firm, or any of its owners, officers or partners been convicted of a crime involving the awarding of a contract for a government construction project, or the bidding or performance of a government contract?

   ☐ Yes ☐ No

6. Answer either subsection A or B, as applicable:

A. Your firm has completed three or more government construction contracts in Sacramento County within the last five years: Within those five years, has your firm been assessed liquidated damages on three or more government construction contracts in Sacramento County for failure to complete contract work on time?

NOTE: If there is a pending administrative or court action challenging the assessment of liquidated damages on a government contract within the last five years, you need not include that contract in responding to this question.

☐ Yes ☐ No ☐ Not applicable

OR

B. Your firm has not completed at least three government construction contracts in Sacramento County within the last five years: Within the last three years, has your firm been assessed liquidated damages on three or more government construction contracts for failure to complete contract work on time?

NOTE: If there is a pending administrative or court action challenging an assessment of liquidated damages on a government contract within the last three years, you need not include that contract in responding to this question.

☐ Yes ☐ No ☐ Not applicable

7. In the last three years has your firm been debarred from bidding on, or completing, any government agency or public works construction contract for any reason?

NOTE: If there is a pending administrative or court action challenging a debarment, you need not include that debarment in responding to this question.

☐ Yes ☐ No

8. Has CAL OSHA assessed a total of three or more penalties against your firm for any "serious" or "willful" violation occurring on construction projects performed in Sacramento County at any time within the last three years?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☐ No

9. Answer <u>either</u> subsection A or B, as preferred:

A. In the last three years has your firm had a three year average Workers' Compensation experience modification rate exceeding 1.1?

☐ Yes ☐ No

OR

B. In the last three years has your firm had a three-year average incident rate for total lost workday cases exceeding 10?

NOTE: Incident rates represent the number of lost workday cases per 100 full-time workers and is to be calculated as: (N/EH) x 200,000, where

N	**=**	**number of lost workday cases (as defined by the U.S. Dept. of Labor, Bureau of Labor Statistics)**
EH	**=**	**total hours worked by all employees during the calendar year**
200,000	**=**	**base for 100 equivalent full-time working (working 40 hours per week, 50 weeks per year)**

☐ Yes ☐ No

10. In the past three years, has the federal EPA, Region IX or a California Air Quality Management District or Regional Water Quality Control Board assessed penalties three or more times, either against your firm, or against the project owner for a violation resulting in whole or in part from any action or omission by your firm on a project on which your firm was a contractor in Sacramento County?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☐ No

11. In the past three years, has the federal EPA, Region IX or a California Air Quality Management District or Regional Water Quality Control Board assessed a single penalty of $100,000 or more, either against your firm, or against the project owner for a violation resulting in whole or in part from any action or omission by your firm on a project on which your firm was the contractor in Sacramento County?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☐ No

12. In the past three years, have civil penalties been assessed against your firm pursuant to California Labor Code 1777.7 for violation of California public works apprenticeship requirements, three or more times?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☐ No

13. In the past three years, has a public agency in California withheld contract payments or assessed penalties against your firm for violation of public works prevailing wage requirements, three or more times?

NOTE: If there is a pending administrative or court action appealing a withholding or penalty assessment, you need not include that withholding or penalty assessment in responding to this question.

☐ Yes ☐ No

14. Has your firm been assessed penalties for violation of public works prevailing wage requirements in California, in an aggregate amount for the past three years of $50,000 or more?

NOTE: If there is a pending administrative or court action appealing a penalty assessment, you need not include that penalty assessment in responding to this question.

☐ Yes ☐ No

VERIFICATION AND SIGNATURE

I, the undersigned, certify and declare that I have read all the foregoing answers to this Minimum Qualifications Questionnaire, and know their contents. The matters stated in these Questionnaire answers are true of my own knowledge and belief, except as to those matters stated on information and belief, and as to those matters I believe them to be true. I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Signed at _____, on _____.
(Location) (Date)

Signature: _____

Print name: _____

Title: _____

NOTE: If two or more entities submit a bid on a contract as a Joint Venture, each entity within the Joint Venture must submit a separate Minimum Qualifications Questionnaire.

REQUIREMENTS OF THE NON-DISCRIMINATION IN EMPLOYEE BENEFITS CODE

INTRODUCTION

The Sacramento Non-Discrimination In Employee Benefits Code (the "Ordinance"), codified as Sacramento City Code Chapter 3.54, prohibits City contractors from discriminating in the provision of employee benefits between employees with spouses and employees with domestic partners, and between the spouses and domestic partners of employees.

APPLICATION

The provisions of the Ordinance apply to any contract or agreement (as defined below), between a Contractor and the City of Sacramento, in an amount exceeding $100,000.00. The Ordinance applies to that portion of a contractor's operations that occur: (i) within the City of Sacramento; (ii) on real property outside the City of Sacramento if the property is owned by the City or if the City has a right to occupy the property; or (iii) at any location where a significant amount of work related to a City contract is being performed.

The Ordinance does not apply: to subcontractors or subcontracts of any Contractor or contractors; to transactions entered into pursuant to cooperative purchasing agreements approved by the Sacramento City Council; to legal contracts of other governmental jurisdictions or public agencies without separate competitive bidding by the City; where the requirements of the ordinance will violate or are inconsistent with the terms or conditions of a grant, subvention or agreement with a public agency or the instructions of an authorized representative of any such agency with respect to any such grant, subvention or agreement; to permits for excavation or street construction; or to agreements for the use of City right-of-way where a contracting utility has the power of eminent domain.

DEFINITIONS

As set forth in the Ordinance, the following definitions apply:

"Contract" means an agreement for public works or improvements to be performed, or for goods or services to be purchased or grants to be provided, at the expense of the City or to be paid out of moneys deposited in the treasury or out of the trust money under the control or collected by the City. "Contract" also means a written agreement for the exclusive use ("exclusive use" means the right to use or occupy real property to the exclusion of others, other than the right reserved by the fee owner) or occupancy of real property for a term exceeding 29 days in any calendar year, whether by singular or cumulative instrument, (i) for the operation or use by others of real property owned or controlled by the City for the operation of a business, social, or other establishment or organization, including leases, concessions, franchises and easements, or (ii) for the City's use or occupancy of real property owned by others, including leases, concessions, franchises and easements.

"Contract" shall not include: a revocable at-will use or encroachment permit for the use of or encroachment on City property regardless of the ultimate duration of such permit; excavation, street construction or street use permits; agreements for the use of City right-of-way where a contracting utility has the power of eminent domain; or agreements governing the use of City property that constitute a public forum for activities that are primarily for the purpose of espousing or advocating causes or ideas and that are generally protected by the First Amendment to the United States Constitution or that are primarily recreational in nature.

“Contractor” means any person or persons, firm partnership or corporation, company, or combination thereof, that enters into a Contract with the City. “Contractor” does not include a public entity.

“Domestic Partner” means any person who has a currently registered domestic partnership with a governmental entity pursuant to state or local law authorizing the registration.

“Employee Benefits” means bereavement leave; disability, life, and other types of insurance; family medical leave; health benefits; membership or membership discounts; moving expenses; pension and retirement benefits; vacation; travel benefits; and any other benefit given to employees. “Employee benefits” shall not include benefits to the extent that the application of the requirements of this chapter to such benefits may be preempted by federal or state.

CONTRACTOR’S OBLIGATION TO PROVIDE THE CITY WITH DOCUMENTATION AND INFORMATION

Contractor shall provide the City with documentation and information verifying its compliance with the requirements of the Ordinance within ten (10) days of receipt of a request from the City. Contractors shall keep accurate payroll records, showing, for each City Contract, the employee’s name, address, Social Security number, work classification, straight time pay rate, overtime pay rate, overtime hours worked, status and exemptions, and benefits for each day and pay period that the employee works on the City Contract. Each request for payroll records shall be accompanied by an affidavit to be completed and returned by the Contractor, as stated, attesting that the information contained in the payroll records is true and correct, and that the Contractor has complied with the requirements of the Ordinance. A violation of the Ordinance or noncompliance with the requirements of the Ordinance shall constitute a breach of contract.

EMPLOYER COMPLIANCE CERTIFICATE AND NOTICE REQUIREMENTS

(a) All contractors seeking a Contract subject to the Ordinance shall submit a completed Declaration of Compliance Form (attachment “A”), signed by an authorized representative, with each proposal, bid or application. The Declaration of Compliance shall be made a part of the executed contract, and will be made available for public inspection and copying during regular business hours.

(b) The Contractor shall give each existing employee working directing on a City contract, and (at the time of hire), each new employee, a copy of the notification provided as attachment “B.”

(c) Contractor shall post, in a place visible to all employees, a copy of the notice provided as attachment “C.”

DECLARATION OF COMPLIANCE
Equal Benefits Ordinance

_____
Name of Contractor

_____
Address

The above named contractor ("Contractor") hereby declares and agrees as follows:

1. I have read and understand the Requirements of the Non-Discrimination In Employee Benefits Code (the "Requirements") provided to me by the City of Sacramento ("City") in connection with the City's request for proposals or other solicitations for the performance of services, or for the provision of commodities, under a City contract or agreement ("Contract").

2. As a condition of receiving the City Contract, I agree to fully comply with the Requirements, as well as any additional requirements that may be specified in the City's Non-Discrimination in Employee Benefits Code codified at Chapter 3.54 of the Sacramento City Code (the "Ordinance").

3. I understand, to the extent that such benefits are not preempted or prohibited by federal or state law, employee benefits covered by the Ordinance, are any of the following:

   a. Bereavement Leave
   b. Disability, life, and other types of insurance
   c. Family medical leave
   d. Health benefits
   e. Membership or membership discounts
   f. Moving expenses
   g. Pension and retirement benefits
   h. Vacation
   i. Travel benefits
   j. Any other benefit offered to employees

   I agree that should I offer any of the above listed employee benefits, that I will offer those benefits, without discrimination between employees with spouses and employees with domestic partners, and without discrimination between the spouses and domestic partners of such employees.

4. I understand that I will not be considered to be discriminating in the provision or application of employee benefits under the following conditions or circumstances:

   a. In the event that the actual cost of providing a benefit to a domestic partner or spouse, exceeds the cost of providing the same benefit to a spouse or domestic partner of an employee, I will not be required to provide the benefit, nor shall it be deemed discriminatory, if I require the employee to pay the monetary difference in order to provide the benefit to the domestic partner or to the spouse.

   b. In the event I am unable to provide a certain benefit, despite taking reasonable measures to do so, if I provide the employee with a cash equivalent, I will not be deemed to be discriminating in the application of that benefit.

   c. If I provide employee benefits neither to employee's spouses nor to employee's domestic partners.

   d. If I provide employee benefits to employees on a basis unrelated to marital or domestic partner status.

   e. If I submit, to the Program Coordinator, written evidence of making reasonable efforts to end discrimination in employee benefits by implementing policies which are to be enacted before the

first effective date after the first open enrollment process following the date the Contract is executed with the City.

I understand that any delay in the implementation of such policies may not exceed one (1) year from the date the Contract is executed with the City, and applies only to those employee benefits for which an open enrollment process is applicable.

f. Until administrative steps can be taken to incorporate, in the infrastructure, nondiscrimination in employee benefits

The time allotted for these administrative steps will apply only to those employee benefits for which administrative steps are necessary and may not exceed three (3) months from the date the Contract is executed with the City.

g. Until the expiration of a current collective bargaining agreement(s) where, in fact, employee benefits are governed by a collective bargaining agreement(s).

h. I take all reasonable measures to end discrimination in employee benefits by either requesting the union(s) involved agree to reopen the agreement(s) in order for me to take whatever steps are necessary to end discrimination in employee benefits or by my ending discrimination in employee benefits without reopening the collective bargaining agreement(s).

i. In the event I cannot end discrimination in employee benefits despite taking all reasonable measures to do so, I provide a cash equivalent to eligible employees for whom employee benefits (as listed previously), are not available.

Unless otherwise authorized in writing by the City Manager, I understand this cash equivalent must begin at the time the union(s) refuse to allow the collective bargaining agreement(s) to be reopened or no longer than three (3) months from the date the Contract is executed with the City.

5. I understand that failure to comply with the provisions of Section 4. (a) through 4. (i), above, will subject me to possible suspension and/or termination of this Contract for cause; repayment of any or all of the Contract amount disbursed by the City; debarment for future contracts until all penalties and restitution have been paid in full; deemed ineligible for future contracts for up to two (2) years; the imposition of a penalty, payable to the City, in the sum of $50.00 for each employee, for each calendar day during which the employee was discriminated against in violation of the provisions of the Ordinance.

6. I understand and do hereby agree to provide each current employee and, within ten (10) days of hire, each new employee, of their rights under the Ordinance. I further agree to maintain a copy of each such letter provided, in an appropriate file for possible inspection by an authorized representative of the City. I also agree to prominently display a poster informing each employee of these rights.

7. I understand that I have the right to request an exemption to the benefit provisions of the Ordinance when such a request is submitted to the Procurement Services Division, in writing with sufficient justification for resolution, prior to contract award.

I further understand that the City may request a waiver or exemption to the provisions or requirements of the Ordinance, when only one contractor is available to enter into a contract or agreement to occupy and use City property on terms and conditions established by the City; when sole source conditions exist for goods, services, public project or improvements and related construction services; when there are no responsive bidders to the Ordinance requirements and the contract is for essential goods or services; when emergency conditions with public health and safety implications exist; or when the contract is for specialized legal services if in the best interest of the City.

8. In consideration of the foregoing, I shall defend, indemnify and hold harmless, the City, its officers and employees, against any claims, actions, damages, costs (including reasonable attorney fees), or other liabilities of any kind arising from any violation of the Requirements or of the Ordinance by me.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that I am authorized to bind the Contractor to the provisions of this Declaration.

_____ _____

Signature of Authorized Representative Date

_____

Print Name

_____

Title

YOUR RIGHTS UNDER THE CITY OF SACRAMENTO'S

NON-DISCRIMINATION IN EMPLOYEE BENEFITS BY CITY CONTRACTORS ORDINANCE

On …….. (date), your employer (the "Employer") entered into a contract with the City of Sacramento (the "City") for …….. (contract details), and as a condition of that contract, agreed to abide by the requirements of the City's Non-Discrimination In Employee Benefits By City Contractors Ordinance (Sacramento City Code Section 3.54).

The Ordinance does not require the Employer to provide employee benefits. The Ordinance does require that if certain employee benefits are provided by the Employer, that those benefits be provided without discrimination between employees with spouses and employees with domestic partners, and without discrimination between the spouse or domestic partner of employees.

The Ordinance covers any employee working on the specific contract referenced above, but only for the period of time while those employees are actually working on this specific contract.

The included employee benefits are:

- Bereavement leave
- Disability, life and other types of insurance
- Family medical leave
- Health benefits
- Membership or membership discounts
- Moving expenses
- Pension and retirement benefits
- Vacation
- Travel benefits
- Any other benefits given to employees

(Employee Benefits does not include benefits that may be preempted by federal or state law.)

If you feel you have been discriminated or retaliated against by your employer in the terms and conditions of your application for employment, or in your employment, or in the application of these employee benefits, because of your status as an applicant or as an employee protected by the Ordinance, or because you reported a violation of the Ordinance, and after having exhausted all remedies with your employer,

You May . . .

- Submit a written complaint to the City of Sacramento, Contract Services Unit, containing the details of the alleged violation. The address is:

  City of Sacramento
  Contract Services Unit
  915 I St., 2nd Floor
  Sacramento, CA 95814

- Bring an action in the appropriate division of the Superior Court of the State of California against the Employer and obtain the following remedies:

  - Reinstatement, injunctive relief, compensatory damages and punitive damages

  - Reasonable attorney's fees and costs

YOUR RIGHTS UNDER THE CITY OF SACRAMENTO'S

NON-DISCRIMINATION IN EMPLOYEE BENEFITS BY CITY CONTRACTORS ORDINANCE

If your employer provides employee benefits, they must be provided to those employees working on a City of Sacramento contract without discriminating between employees with spouses and employees with domestic partners.

The included employee benefits are:

- Bereavement leave
- Disability, life and other types of insurance
- Family medical leave
- Health benefits
- Membership or membership discounts
- Moving expenses
- Pension and retirement benefits
- Vacation
- Travel benefits
- Any other benefits given to employees

If you feel you have been discriminated against by your employer . . .

You May . . .

- Submit a written complaint to the City of Sacramento, Contract Services Unit, containing the details of the alleged violation. The address is:

  City of Sacramento
  Contract Services Unit
  915 I St., 2nd Floor
  Sacramento, CA 95814

- Bring an action in the appropriate division of the Superior Court of the State of California against the employer and obtain reinstatement, injunctive relief, compensatory damages, punitive damages and reasonable attorney's fees and costs.

Discrimination and Retaliation Prohibited.

If you feel you have been discriminated or retaliated against by your employer in the terms and conditions of your application for employment, or in your employment, because of your status as an applicant or as an employee protected by the Ordinance, or because you reported a violation of this Ordinance . . .

You May Also . . .

Submit a written complaint to the City of Sacramento, Contract Services Unit, at the same address, containing the details of the alleged violation.

Construction and Demolition (C&D) Debris Recycling Requirements

As a condition of receiving this Contract, Contractor agrees to fully comply with the requirements specified herein for all demolition projects, as well as projects with a valuation of $250,000 or more:

1. **Definitions**. For purposes of this section, the following terms, words and phrases shall have the following meanings:

"Certified C&D sorting facility" means a facility that receives C&D debris and/or processes C&D debris into its component material types for reuse, recycling, and disposal of residuals and possesses a valid certificate as a C&D sorting facility from the Sacramento Regional County Solid Waste Authority.

"Construction and demolition debris" or "C&D debris" means used or commonly discarded materials resulting from construction, repair, remodel or demolition operations on any pavement, house, building, or other structure, or from landscaping that are not hazardous as defined in California Health and Safety Code section 25100 et seq. Such materials include, but are not limited to, concrete, asphalt, wood, metal, brick, dirt, sand, rock, gravel, plaster, glass, gypsum wallboard, cardboard and other associated packaging, roofing material, ceramic tile, carpeting, masonry, plastic pipe, trees, and other vegetative matter resulting from land clearing and landscaping.

"Divert" or "diversion" means to use materials for any purpose other than disposal in a landfill or transformation facility. Methods to divert materials include on-site reuse of the materials, delivery of materials from the project site to a certified C&D sorting facility or a recycling facility, or other methods as approved in regulations promulgated by the City Department of Utilities.

"Franchised waste hauler" means a person who possesses a valid commercial solid waste collection franchise issued by the Sacramento Regional County Solid Waste Authority.

"Mixed C&D debris" means loads that include commingled recyclable and non-recyclable C&D debris generated at a project site.

"Recyclable C&D debris" means C&D debris required to be diverted from landfills as specified in the Waste Management Plan and returned to the economic mainstream in the form of raw material for new, reused or reconstituted products that meet the quality standards necessary to be used in the marketplace.

"Recycling facility" means a facility or operation that receives, processes, and transfers source-separated recyclable materials.

"Source-separated C&D debris" means recyclable C&D debris that is separately sorted and containerized at the site of generation by individual material type and segregated from mixed C&D debris prior to collection and transporting.

"Waste log" means a record detailing the management of C&D debris generated by the covered project, including the date and weight/volume of material by type that was salvaged, reused, recycled or disposed.

2. **Waste Management Plan**. A completed WMP (see **Attachment 1**) must be submitted to and approved by the City prior to commencing any work on the project. The WMP must specify the types of C&D debris that will be generated from the project; the manner in which C&D debris will be managed and/or stored on the project site; the manner in which recyclable C&D debris generated from the project will be recycled or reuse; the person who will haul, collect or transport the recyclable C&D debris from the project site; and the certified C&D sorting facility or recycling facility where recyclable C&D debris will be delivered. The WMP must be approved by the City prior to commencing any work on the project.

3. Contractor shall be solely responsible for diverting the recyclable C&D materials specified on the WMP. Mixed C&D debris shall be delivered to a SWA-certified C&D sorting facility only. Only the permit holder, the person who generates the waste, a franchised waste hauler, or the City of Sacramento can transport or haul mixed C&D debris. Source-separated C&D debris may be delivered by any person to any recycling facility that accepts such materials. (See **Attachment 2** for list of C&D Debris Haulers and Facilities).

4. During the course of the project, Contractor shall maintain a waste log (see **Attachment 3**), and keep all weight tickets or weight receipts, for all C&D debris hauled away from the project. At a minimum, the waste log shall specify the C&D debris generated by the project; the manner in which C&D debris was recycled or re-used; and the facility where the C&D debris was delivered.

5. Within 30 days after submitting the project completion report, Contractor shall submit to the City a completed waste log, along with copies of supporting weight tickets. Contractor shall maintain and keep accurate and complete records of al bills, weight receipts or weight tickets that were issued for the collection, transport or disposal of C&D debris for a period of one-year after submittal of the waste log. The records shall be made available for inspection, examination and audit by the City during the one-year retention period to validate the information provided in the WMP and in the waste log. If the City determines noncompliance by the Contractor after an audit has been conducted, Contractor shall reimburse the City for all costs incurred in performing the audit.

6. Failure by Contractor to comply with any provisions specified herein will subject Contractor to possible suspension and/or termination of this Contract for cause; repayment of any or all of the Contract amount disbursed by the City; imposition of a penalty, payable to the City ($50-$250 for first offense, $251-$500 for second offense, and $501-$1500 for subsequent offenses); and/or submission of a performance security deposit fee when submitting a permit application to the City for a project within one year of imposition of the penalty.

For questions or to obtain more information about the Recycling Requirements for C&D debris, contact the City of Sacramento, Solid Waste Services Division, 2812 Meadowview Road, Building 1, Sacramento, CA 95832, or telephone (916) 808-4833, or email C&D@cityofsacramento.org

C&D Debris Waste Management Plan

C&D Debris Waste Management Plan
City of Sacramento Solid Waste Services
2812 Meadowview Road, Building 1
Sacramento, CA 95832
Phone: (916) 808-4839 / Fax: (916) 808-4999
C&D@cityofsacramento.org

Form submitted by:	
	Please attach a business card, or put your name with a phone number and/or an email address.

This Waste Management Plan (WMP) must be submitted and approved before work can begin. Only one WMP is required for each public construction project. The administration fee and, if applicable, a security deposit must be submitted with this form to be approved. Administration fee is 0.04% of project bid amount (min $40, max $800); security deposit, if applicable, is 1% of bid amount (max $10,000). The accompanying Waste Log must be submitted within 30 days of the project completion report, or a penalty may be imposed.

A. Building Project Information:

Job Address: _____ Engineering Estimate: _____
Contractor: _____ Phone: _____
Address: _____ Email: _____

B. Briefly describe the project:

_____

_____

_____

_____

_____

C. Materials Required to be Recycled

50% of all debris must be recycled if generated during the course of your project. You can either **source-separate** them, which may be hauled by anyone, or mix them in one container and send the **mixed C&D debris** load to a **Certified Mixed C&D Sorting Facility**. Mixed C&D loads can only be hauled by a franchised hauler or self-hauled. Please see the Definitions section, on the next page, for more information.

50%
of all debris must be recycled

D. Material Management.

1. **How will C&D debris will be stored on the project site**: _____ Mixed C&D _____ Source-Separated
2. **Company to haul away debris**: _____
3. **Facilities to receive debris**: _____

E. Definitions.

Please read and understand these terms. Call Solid Waste at (916) 808-4833 if these terms are not clear to you. More information is also available online at http://www.cityofsacramento.org/utilities/.

1. **Self-haul or self-hauling**: This is when the general contractor or a subcontractor *who is doing work on the project* hauls their own waste materials for recycling or disposal. Note that a *jobsite cleanup crew is not doing other work on the project and is not self-hauling*. Jobsite cleanup crews need to be franchised in order to haul mixed C&D debris away.

2. **Franchised hauler**: Check the Department of Utilities (DOU) website for a list of these haulers. Only these companies and the City of Sacramento can collect and haul mixed C&D debris generated within the City for a fee.

3. **Source separation**: This means keeping wood, metal, cardboard, or other recyclables in separate containers, and sending the materials to an authorized recycler. A list of authorized recyclers can be found on the DOU web site. Source-separated materials may be hauled by anyone.

4. **Mixed C&D debris**: This means putting all recyclable debris into one container. Mixed materials must be sent to a certified mixed C&D sorting facility. Mixed materials may be either self-hauled or hauled by a franchised hauler. If your job site is crowded, this option saves the most space.

5. **Certified Mixed C&D Sorting Facility**: See the DOU web site for a list. These facilities have been certified by the Sacramento Regional Solid Waste Authority (SWA) to extract recyclable materials from mixed C&D debris.

F. Terms and Conditions

- Your approved Waste Management Plan and Waste Log must be kept on the job site for the duration of the project.
- City of Sacramento Solid Waste Services staff may enter the jobsite to inspect waste collection areas.
- **ALL** Clean Wood Waste (unpainted, untreated lumber, plywood and OSB), Inert Materials (concrete, asphalt paving, brick, block, and dirt), Wooden Pallets, Scrap Metal, and Corrugated Cardboard must be recycled.
- Only SWA-Certified Mixed C&D Sorting Facilities may be used to recycle these materials if mixed with other materials.
- Only the City of Sacramento, SWA-Franchised Haulers, or self-haulers (as defined above) may collect and transport mixed C&D material from the jobsite.
- C&D Debris may not be burned or dumped illegally.
- Your Waste Log must be completed and submitted, with supporting weight tickets, within 30 days of submitting your project completion report. All waste hauling and disposal or recycling activity must be entered on the Waste Log, including information from any subcontractors who self-hauled their own debris off-site.
- You must keep all receipts or weight-tickets from your project for a period of one year from the submittal of your waste log.
- Failure to comply with these terms and conditions may result in a fine and payment of a security deposit on future projects

C&D Debris Haulers & Facilities

C&D Debris Waste Management Plan
City of Sacramento Solid Waste Services
2812 Meadowview Road, Building 1
Sacramento, CA 95832
Phone: (916) 808-4833 / Fax: (916) 808-4999
C&D@cityofsacramento.org

Certified Mixed C&D Facilities

Allied Waste / Elder Creek Transfer and Recovery	(916) 387-8425
Florin-Perkins Public Disposal	(916) 443-5120
L&D Landfill	(916) 737-8640
Waste Management / K&M Recycle America	(916) 452-0142

Franchised Haulers

ACES Waste Services, Inc.	(866) 488-8837	Elk Grove Waste Management, LLC	(916) 689-4052
Allied Waste Services	(916) 631-0600	Mini Drops, Inc.	(916) 686-8785
All Waste Systems, Inc.	(916) 456-1555	Norcal Waste Services of Sacramento	(916) 381-5300
Atlas Disposal Industries, LLC	(916) 455-2800	North West Recyclers	(916) 686-8575
California Waste Recovery Systems	(916) 441-1985	Waste Management of Sacramento	(916) 387-1400
Central Valley Waste Services, Inc.	(209) 369-8274	Waste Removal & Recycling	(916) 453-1400
City of Sacramento Solid Waste	(916) 808-4839	Western Strategic Materials, Inc.	(916) 388-1076

Recyclers*

Bell Marine	(916) 442-9089
C & C Paper Recycling	(916) 920-2673
EBI Aggregates	(916) 372-7580
International Paper	(916) 371-4634
Modern Waste Solutions	(916) 447-6800
PRIDE Industries, Inc.	(916) 640-1300
Recycling Industries, Inc.	(916) 452-3961
Sacramento Local Conservation Corps	(916) 386-8394
Smurfit-Stone Container Corporation	(916) 381-3340
Southside Art Center	(916) 387-8080
Spencer Building Maintenance, Inc.	(916) 922-1900

Recovery Stations & Landfills

Elder Creek Recovery & Transfer Station	(916) 387-8425
Kiefer Landfill	(916) 875-5555
L & D Landfill	(916) 383-9420
North Area Recovery Station	(916) 875-5555
Sacramento Recycling & Transfer Station	(916) 379-0500
Waste Management Recycle America	(916) 452-0142

More updated information can be found online at:
http://www.cityofsacramento.org/utilities/

* Please note that any facility may receive source-separated recyclable materials as long as it is authorized to do so by the State of California. This is not meant to be a complete list.

C&D Debris Waste Log

C&D Debris Waste Management Plan
City of Sacramento Solid Waste Services
2812 Meadowview Road, Building 1
Sacramento, CA 95832
Phone: (916) 808-4839 / Fax: (916) 808-4999
C&D@cityofsacramento.org

Project address: _____

This waste log, and copies of supporting weight tickets, must be submitted to Solid Waste within 30 days of submitting the project completion report. The waste log and weight tickets must also be kept on file for one year after project completion.

Date	Hauler	Material	Destination	Amount

Hauler: Indicate the Franchisee, Self-Hauler, City of Sacramento, or other hauler who removed the material offsite.
Material: Indicate appropriate category: Scrap Metal, Inert Materials, Cardboard, Wooden Pallets, or Clean Wood Waste.
Destination: Indicate the facility that received the material for disposal or recycling
Amount: Indicate the weight. If weight is not known, put volume.

.

Green Contracting Survey
(Voluntary)

The City of Sacramento and the Sacramento Metropolitan Air Quality District (SMAQMD) are conducting a joint pilot project to help meet Federal Clean Air Standards for the Sacramento region.

Attached is a Green Contracting Fleet Inventory Form. Please complete the form, remove it from the bid package and return it to SMAQMD in the postage paid envelope provided with the bid package. Please do not return the Green Contracting Fleet Inventory Form to the City of Sacramento with the bid documents or otherwise.

A limited amount of funds and other financial incentives may be available to qualified contractors participating in this joint project to assist qualified contractors with upgrading and/or replacing equipment and/or trucks.

Completing and returning the Green Contracting Fleet Inventory Form is strictly voluntary

Voluntary Green Contracting Fleet Inventory List (On-Road Equipment)

In partnership with the City of Sacramento and the Sacramento Metropolitan Air Quality Management District

Company Name:	
Contact Name:	
Company Address:	
City, State, ZIP:	
Company Phone:	

	City Bid Information
Department	
Project #	
LBE	

Instructions:

a) Please enter the vehicle / equipment information for each unit used in conjunction with your City of Sacramento Bid.
b) All fields are required for both on-road heavy-duty vehicles and off-road construction equipment over 50 HP.
c) Electronic version available at http://www.airquality.org/ceqa/index.shtml
d) For additional questions, please call (916) 874-4892

Please Submit To:

Kristian Damkier, P.E.
Sacramento Metropolitan AQMD
777 12th St, 3rd Floor
Sacramento, CA 95814-1908

#	VIN	License Plate	Vehicle Information			Engine Information				Annual Usage (miles)	Received Funding
			Make	Model	Year	Make	Model	Year	HP		
(ex)	*1XP5AAC35RG339402*	*1T45678*	*Kenworth*	*T-300*	*2002*	*Cummins*	*ISB*	*2002*	*250*	*35,000*	*No*

Voluntary Green Contracting Fleet Inventory List (On-Road Equipment)

In partnership with the City of Sacramento and the Sacramento Metropolitan Air Quality Management District

Company Name:	
Contact Name:	
Company Address:	
City, State, ZIP:	
Company Phone:	

	City Bid Information
Department	
Project #	
LBE	

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Please Submit To:

Kristian Damkier, P.E.
Sacramento Metropolitan AQMD
777 12th St, 3rd Floor
Sacramento, CA 95814-1908

Equipment Serial Number	Equipment Information				Engine Information				Annual Usage (hours)
	Make	Model	Type	Year	Make	Model	Year	HP	
48W34456	*Caterpillar*	*631G*	*Scraper*	*2003*	*Caterpillar*	*3408E*	*2003*	*485*	*1,600*

LOCAL BUSINESS ENTERPRISE (LBE) PARTICIPATION REQUIREMENTS FOR PUBLIC PROJECTS OF $100,000 OR MORE

(City Contracts no Federal Funds Used)

I. LBE PARTICIPATION REQUIREMENT

On April 3, 2012, the Sacramento City Council adopted a Local Business Enterprise (LBE) Preference Program to provide enhanced opportunities for the participation of local business enterprises (LBEs) in the City's contracting and procurement activities. On November 19, 2013, the City Council increased the LBE preference percentage and authorized City departments to require minimum LBE participation levels in specific contracts. Under City Code section 3.60.270, when the bid specifications for a City contract establish a minimum participation level for LBEs, no bidder on the contract shall be considered responsive unless its bid meets the minimum LBE participation level required by the bid specifications.

The City has established **a minimum 5% participation level for LBEs on this contract**. Pursuant to City Code Section 3.60.270, no bidder on this contract shall be considered responsive unless its bid meets or exceeds this minimum participation level.

Bidder and any other business entity listed on the LBE forms submitted shall comply with all applicable laws relating to licensing, permitting, and payment of taxes and fees in the City of Sacramento or County of Sacramento; and shall not be in arrears to the City of Sacramento or County of Sacramento, upon award of a contract.

II. LBE QUALIFICATION

A. A LBE designated in the bid must be qualified as a LBE prior to the time set for submission of bids.

B. Local Business Enterprise means a business enterprise, including but not limited to, a sole proprietorship, partnership, limited liability company, corporation, or other business entity that has a legitimate business presence in the City or unincorporated county of Sacramento. Proof of legitimate business presence in the City or unincorporated county of Sacramento shall include:

1. Having a current City of Sacramento Business Operation Tax or County of Sacramento Business License for at least twelve (12) consecutive months prior to submission of bid; and
2. Having either of the following types of offices or workspace operating legally within the City or unincorporated county of Sacramento for at least twelve (12) consecutive months prior to submission of bid:
    a. The LBE's principle business office or workspace; or
    b. The LBE's regional, branch or satellite office with at least one full time employee located in the City or unincorporated county of Sacramento.

C. A LBE must provide a physical address for the basis of location. This excludes P.O. Box addresses.

D. A LBE must provide a current copy of the City of Sacramento Business Operations Tax Certificate or County of Sacramento Business License.

III. DETERMINATION OF LBE PARTICIPATION LEVEL

A. LBE Participation: The percentage of LBE participation is determined based on the dollar value of the work to be performed or supplies to be furnished by certified LBEs designated in the bidder's Subcontractor and LBE Participation Verification Form, relative to the total dollar amount of the bid.

B. Participation Credit: To receive credit for participation:(1) a LBE subcontractor must be responsible for the execution of a distinct element of the work, must possess any license or certification required for the work, and must actually perform, manage, or supervise the work without subcontracting or otherwise shifting any portion of the work to another subcontractor; and (2) a LBE supplier must furnish materials, equipment, or supplies that the supplier sells as a recurring, although not necessarily primary, part of its business, and that are necessary for performance of the work.

C. Suppliers: Credit for a LBE supplier of materials, equipment, or supplies is counted as one hundred (100) percent of the amount paid to the supplier for the material, equipment, or supplies. To receive this credit, LBE suppliers must be listed on the bidder's Subcontractor and LBE Participation Verification Form.

D. Subcontractors (including truckers): To receive credit for a LBE subcontractor, the subcontractor must be listed on the bidder's Subcontractor and LBE Participation Verification Form.

- Truckers: Credit for a LBE trucker is counted as one hundred (100) percent of the amount paid to the trucker for trucking services, not including any amount paid to the trucker for the cost of any materials, equipment, or supplies being transported by the trucker.

IV. LBE REQUIREMENTS FOR CONTRACTOR

A. LBE Records: The Contractor shall maintain records of all subcontracts with verified LBE subcontractors and records of materials purchased from verified LBE suppliers for one (1) year after receiving final payment from the City. Such records shall show the name and business address of each LBE subcontractor or supplier and the total dollar amount actually paid each LBE subcontractor or supplier.

Not later than 30 days after completion of the work performed under the contract, a summary of these records shall be prepared, certified correct by the Contractor's authorized representative and furnished to the City. The Contractor shall provide such other information, records, reports, certifications or other documents as may

be required by City, to determine compliance with any provision of the LBE program or these specifications.

B. Performance of LBE Subcontractors and Suppliers: The LBEs listed by the Contractor shall perform the work and supply the materials, equipment, and supplies for which they are listed unless the Contractor has received prior written authorization from the City to perform the work with other forces or to obtain the material, equipment, or supplies from other sources. Reasons for requesting such authorization would include:

1. The listed LBE fails to execute a written contract based upon the general terms, conditions, plans, and specifications for the project.

2. The listed LBE becomes bankrupt or insolvent.

3. The listed LBE subcontractor fails to meet the bond requirements of the Contractor.

4. The work performed or the materials/equipment/supplies provided by the listed LBE are unsatisfactory or are not in accordance with the plans and specifications, or the listed LBE fails to perform its contractual obligations.

5. It would be in the best interest of the City.

C. Subcontractor Substitution: No substitution of a LBE subcontractor shall be made at any time without compliance with the Subletting and Subcontracting Fair Practices Act. If a LBE subcontractor is unable to perform successfully and is to be replaced, the Contractor shall make reasonable efforts to replace the original LBE subcontractor with another verified LBE subcontractor. The new LBE subcontractor must be verified at the time of substitution.

D. Reporting and Utilization Requirements and Sanctions: Failure to provide specific information, records, reports, certifications, or any other documents required for compliance with these specifications, or failure to utilize one or more LBEs in substantial compliance with the LBE utilization indicated in the Contractor's bid (unless otherwise authorized by City as provided herein, or when such failure results from changes to the work approved by the City), shall be considered a breach of the contract, and a deduction may be made from the contract amount. The deduction shall be not more than ten (10) percent of the value of the work or materials/equipment/supplies that the subject LBE(s) were listed to perform/provide in the Contractor's bid, and shall be deducted from any payment due to the Contractor. This is in addition to any deduction that may be made under any other provision of the contract, the Sacramento City Code, or State law.

E. Hearing and Review of Division Manager Decision: Prior to making a deduction pursuant to Section IV (D), above, the City shall provide written notice of the proposed deduction to the Contractor, and the Contractor may, not later than five (5) working days after receiving such notice, provide a written request to City for a hearing to contest the proposed deduction. Upon receipt of a timely written

request from the Contractor, the City shall schedule a hearing before the Division Manager (as defined in the City's Standard Specifications for Public Construction), and written notice of the date, time and location of the hearing shall be provided to the Contractor not less than five (5) working days prior to the date of the hearing. The hearing shall be conducted in the manner specified in Section 4-8 of the Standard Specifications, and the Division Manager shall prepare and forward to the Contractor a written decision as soon as practicable after the hearing. The Division Manager's decision shall be subject to review in accordance with the provisions of Section 4-9 of the Standard Specifications. Failure to request such review in compliance with the requirements set forth in Section 4-9 shall constitute acceptance of the Division Manager's decision by the Contractor.

The written notices and requests described above shall be provided by registered or certified mail (return receipt requested), by telecopy, by personal delivery, or by any other method that provides reliable evidence of the date of receipt. Written notice provided by telecopy shall be deemed received on the date that it is transmitted and transmission is confirmed by the transmitting machine. Written notice provided by personal delivery shall be deemed received on the date of delivery.

V. DEFINITIONS

A. Local Business Enterprise (LBE): A business enterprise, including but not limited to, a sole proprietorship, partnership, limited liability company, corporation, or any other business entity that has a legitimate business presence in the City of Sacramento or unincorporated county of Sacramento.

B. Contractor: The sole proprietorship, partnership, limited liability company, corporation, or any other business entity entering into a contract with the City of Sacramento.

C. Subcontractor: The sole proprietorship, partnership, limited liability company, corporation, or other business entity entering into a contract with the prime contractor to perform a portion of the work.

D. Supplier: The sole proprietorship, partnership, limited liability company, corporation, or other business entity to provide materials, equipment, or supplies necessary for performance of the work.

E. Proposal: Any response to a City solicitation for Proposals or Qualifications.

F. Bid: Any response to a City solicitation for bids.

FOLLOWING FORMS TO BE FILLED OUT AND SIGNED

ONLY

IF AWARDED CONTRACT

WORKER'S COMPENSATION INSURANCE CERTIFICATION

TO THE CITY OF SACRAMENTO:

The undersigned does hereby certify that he is aware of the provisions of Section 3700 et seq. of the Labor Code which require every employer to be insured against liability for worker's compensation claims or to undertake self-insurance in accordance with the provisions of said Code, and that he/she will comply with such provisions before commencing the performance of the work on this contract.

Sierra National Construction, Inc..
Bidder

By: _____

Title: President

Address: 5433 El Camino Ave, Ste 4

Carmichael, Ca 95608

Date: 8/10/16

PLEASE READ CAREFULLY BEFORE SIGNING

To be signed by authorized corporate officer or partner or individual submitting the bid. If bidder is: (example)

1. An individual using a firm name, sign: "John Doe, and individual doing business as Blank Company".
2. An individual doing business under his own name, sign: Your name only.
3. A co-partnership, sign: "John Doe and Richard Doe, co-partners doing business as Blank Company, by, John Doe, Co-Partner".
4. A corporation, sign: "Blank Company, by John Doe, Secretary". (Or other title)

AGREEMENT
(Construction Contract Over $25,000)

THIS AGREEMENT, dated for identification _____, 20___, is made and entered into between the CITY OF SACRAMENTO, a municipal corporation ("City"), and _____("Contractor").

The City and Contractor hereby mutually agree as follows:

1. CONTRACT DOCUMENTS

The Contract Documents, sometimes also referred to as the "Contract," consist of the following items, which are hereby incorporated by reference as if set forth in full in this Agreement:

The Notice to Contractors
The Proposal Form submitted by the Contractor
The Instructions to Bidders
The Local Business Enterprise (LBE) Requirements
The Requirements for the Non-Discrimination in Employee Benefits by City Contractors Ordinance and the Declaration of Compliance
The City's Reference Guide for Construction Contracts
The Addenda, if any
This Agreement
The Standard Specifications
The Special Provisions
The Plans and Technical Specifications
The drawings and other data and all developments thereof prepared by City pursuant to the Contract
Any modifications of any of the foregoing made or approved by City, including but not limited to duly authorized change orders.

Unless specifically noted otherwise, references to the "Standard Specifications" shall mean and refer to the Standard Specifications for Public Construction of the City of Sacramento approved by the Sacramento City Council on June 4, 2007 (Resolution No. 2007-350), and any subsequent amendments thereto approved by the Sacramento City Council or the Sacramento City Manager. Work called for in any one Contract Document and not mentioned in another is to be performed and executed as if mentioned in all Contract Documents. The table of contents, titles and headings contained in the Contract Documents are provided solely to facilitate reference to various provisions of the Contract Documents and in no way affect or limit the interpretation of the provisions to which they refer.

2. DEFINITIONS

Unless otherwise specifically provided herein, all words and phrases defined in the Standard Specifications shall have the same meaning and intent in this Agreement.

3. AGREEMENT CONTROLS

In the event of a conflict between any of the terms and conditions set forth in this Agreement and the terms and conditions set forth in other Contract Documents, the terms and conditions set forth in this Agreement shall prevail, except that the provisions of any duly authorized change order shall prevail over any conflicting provisions of this Agreement.

4. SCOPE OF CONTRACT

Contractor agrees to furnish all tools, equipment, apparatus, facilities, labor, material and transportation necessary to perform and complete in a good and workmanlike manner to the satisfaction of City, all the Work called for in the Contract Documents entitled:

SHASTA PARK WATER FACILITY (PN: Z14005402)

Including the Work called for in the following alternative bid items described in the Proposal Form:

_____

Contractor agrees to perform such Work in the manner designated in and in strict conformity with the Contract Documents.

5. CONTRACT AMOUNT AND PAYMENTS

City agrees to pay and Contractor agrees to accept, as complete payment for the above Work, in accordance with the schedule and procedures set forth in the Contract Documents and subject to deductions, withholdings and additions as specified in the Contract Documents, a total sum that shall not exceed the total bid amount set forth in Contractor's Proposal Form. In addition, subject to deductions, withholdings and additions as specified in the Contract Documents, payment for individual items of the Work shall be computed as follows:

A. For items of the Work for which a lump sum price is specified in Contractor's Proposal Form, Contractor shall be paid the lump sum price(s) specified in Contractor's Proposal Form; and

B. For items of the Work for which a unit price is specified in Contractor's Proposal Form, Contractor shall be paid the sum computed at such unit price, or computed at a different price if such different price is determined by City in accordance with the Standard Specifications, based on the actual amount of each such item performed and/or furnished and incorporated in the Work; provided that in no event shall the total sum for a unit price item exceed the total bid amount set forth for such item in the Contractor's Proposal Form, unless authorized by Change Order.

6. PROGRESS PAYMENTS

Subject to the terms and conditions of the Contract, City shall cause payments to be made upon demand of Contractor as follows:

A. On or about the first of the month, the Engineer shall present to the Contractor a statement showing the amount of labor and materials incorporated in the Work through the twentieth (20) calendar day of the preceding month. After both Contractor and Engineer approve the statement in writing, and the City's labor compliance officer provides written approval, the City shall issue a certificate for ***ninety (90) percent*** of the amount it shall find to be due, subject to any deductions or withholdings authorized or required under the Contract or any applicable Laws or Regulations.

B. No inaccuracy or error in said monthly estimates shall operate to release Contractor from damages arising from such Work or from enforcement of each and every provision of the Contract Documents, and City shall have the right subsequently to correct any error made in any estimate for payment.

C. Contractor shall not be paid for any defective or improper Work.

D. The remaining ***ten (10) percent*** of the value of the Work performed under the Contract, if unencumbered and subject to any deductions or withholdings authorized or required under the Contract or any applicable Laws or Regulations, shall be released not later than sixty (60) days after completion and final acceptance of the Work by City. Acceptance by Contractor of the final payment shall constitute a waiver of all claims against the City arising under the Contract Documents, except for disputed claims in stated amounts that the Contractor specifically reserves in writing, but only to the extent that the Contractor has complied with all procedures

and requirements applicable to the presentation and processing of such claim(s) under the Contract Documents. Contractor shall be entitled to substitute securities for retention or to direct that payments of retention be made into escrow, as provided in Public Contract Code Section 22300, upon execution of the City's Escrow Agreement for Security Deposits in Lieu of Retention.

E. The parties agree that, for purposes of the timely progress payment requirements specified in Public Contract Code Section 20104.50, the date that the City receives a statement jointly approved by the Contractor and the Engineer as provided above shall be deemed to constitute the date that City receives an undisputed and properly submitted payment request from the Contractor. Progress payments not made within 30 days after this date may be subject to payment of interest as provided in Public Contract Code Section 20104.50.

F. This Contract is subject to compliance monitoring and enforcement by the California Department of Industrial Relations, as specified in California Labor Code section 1771.4.

7. RETENTION OF SUMS CHARGED AGAINST CONTRACTOR

When, under the provisions of this Contract or any applicable Laws or Regulations, City is authorized or required to withhold, deduct or charge any sum of money against Contractor, City may deduct and retain the amount of such charge from the amount of the next succeeding progress estimate(s), or from any other moneys due or that may become due Contractor from City. If, on completion or termination of the Contract, sums due Contractor are insufficient to pay City's charges, City shall have the right to recover the balance from Contractor or its Sureties.

8. COMMENCEMENT AND PROSECUTION OF WORK

Contractor shall commence the Work not later than fifteen (15) working days after the date of the written Notice to Proceed from City to Contractor and shall diligently prosecute the Work to final completion. The phase "commence the Work" means to engage in a continuous program on-site including, but not limited to, site clearance, grading, dredging, land filling and the fabrications, erection, or installation of the Work. The Notice to Proceed shall be issued within fifteen (15) calendar days following execution of the Agreement by the City and the filing by Contractor of the required Bonds and proof of insurance, provided that the Engineer may delay issuance of the Notice to Proceed if the Engineer determines in the Engineer's sole discretion that conditions on the site of the Work are unsuitable for commencement of the Work. After the Notice to Proceed is issued, the continuous prosecution of Work by Contractor shall be subject only to Excusable Delays as defined in this Agreement.

9. TIME OF COMPLETION

The entire Work shall be brought to completion in the manner provided for in the Contract Documents on or before **three hundred fifty (350) working** days from the date of the Notice to Proceed (hereinafter called the "Completion Date") unless extensions of time are granted in accordance with the Contract Documents.

Failure to complete the entire Work by the Completion Date and in the manner provided for in the Contract Documents shall subject Contractor to liquidated damages as provided in this Agreement. Time is and shall be of the essence in the performance of the Contract and the Work.

10. PAYMENTS DO NOT IMPLY ACCEPTANCE OF WORK

The payment of any progress payment, or the acceptance thereof by Contractor, shall not constitute acceptance of the Work or any portion thereof and shall in no way reduce the liability of Contractor to replace unsatisfactory work or material, whether or not the unsatisfactory character of such work or material was apparent or detected at the time such payment was made.

11. ACCEPTANCE NOT RELEASE

Contractor shall correct immediately any defective or imperfect work or materials that may be discovered before final acceptance of the entire Work, whether or not such defect or imperfection was previously noticed or identified by the City. The inspection of the Work, or any part thereof, shall not relieve Contractor of any of its obligations to perform satisfactory work as herein specified.

Failure or neglect on the part of City or any of its officers, employees or authorized agents to discover, identify, condemn or reject defective or imperfect work or materials shall not be construed to imply an acceptance of such work or materials, if such defect or imperfection becomes evident at any time prior to final acceptance of the entire Work, nor shall such failure or neglect be construed as barring City from enforcing Contractor's warranty(ies) or otherwise recovering damages or such a sum of money as may be required to repair or rebuild the defective or imperfect work or materials whenever City may discover the same, subject only to any statutes of limitation that may apply to any such claim.

12. CITY'S RIGHT TO TAKE POSSESSION OF THE WORK IN WHOLE OR IN PART

The City shall have the right at any time to enter upon the Work and perform work not covered by this Contract, or to occupy and use a portion of the Work, prior to the date of the final acceptance of the Work as a whole, without in any way relieving Contractor of any obligations under this Contract.

13. NO WAIVER OF REMEDIES

Neither the inspection by City, its officers, employees or agents, nor any certificate or other approval for the payment of money, nor any payment for, nor acceptance of the whole or any part of the Work by City, nor any extensions of time, nor any position taken by City, its officers, employees or its agents shall operate as a waiver of any provision of the Contract Documents nor of any power herein reserved to City or any right to damages herein provided, nor shall any waiver of any breach of this Agreement be held to be a waiver of any other or subsequent breach. All remedies provided in the Contract Documents shall be taken and construed as cumulative; in addition to each and every other remedy herein provided, the City shall have any and all equitable and legal remedies that it would in any case have.

14. WARRANTY

Except as otherwise expressly provided in the Contract Documents, and excepting only items of routine maintenance, ordinary wear and tear and unusual abuse or neglect by City, Contractor warrants and guarantees all Work executed and all supplies, materials and devices of whatsoever nature incorporated in or attached to the Work, or otherwise provided as a part of the Work pursuant to the Contract, to be absolutely free of all defects of workmanship and materials for a period of one year after final acceptance of the entire Work by the City. Contractor shall repair or replace all work or material, together with any other work or material that may be displaced or damaged in so doing, that may prove defective in workmanship or material within this one year warranty period without expense or charge of any nature whatsoever to City.

In the event that Contractor shall fail to comply with the conditions of the foregoing warranty within ten (10) days after being notified of the defect in writing, City shall have the right, but shall not be obligated, to repair, or obtain the repair of, the defect and Contractor shall pay to City on demand all costs and expense of such repair. Notwithstanding anything herein to the contrary, in the event that any defect in workmanship or material covered by the foregoing warranty results in a condition that constitutes an immediate hazard to public health or safety, or any property interest, or any person, City shall have the right to immediately repair, or cause to be repaired, such defect, and Contractor shall pay to City on demand all costs and expense of such repair. The foregoing statement relating to hazards to health, safety or property shall be deemed to include both temporary and permanent repairs that may be required as determined in the sole discretion and judgment of City.

In addition to the above, the Contractor shall make a written assignment of all manufacturer's and other product warranties to the City, prior to completion and final acceptance of the Work by City.

The Contractor's Performance Bond shall secure the performance of the Contractor's obligations under this Section 14, and the Contractor and its Surety shall be jointly and severally liable for these obligations.

15. LIQUIDATED DAMAGES IF WORK NOT COMPLETED ON TIME

A. The actual fact of the occurrence of damages and the actual amount of the damages that City would suffer if the entire Work, and/or any specified portion thereof, were not completed within the time(s) specified herein are dependent upon many circumstances and conditions that could prevail in various combinations, and for this reason, it is impracticable and extremely difficult to fix the actual damages. Damages that City would suffer in the event of such delay include: loss of the use of the project; expenses of prolonged assignment to the project of an architectural and/or engineering staff; prolonged costs of administration, inspection, and supervision; increased operational expenses and/or impaired operation of other facilities dependent upon completion of the project; and the loss and inconvenience suffered by the public within the City of Sacramento by reason of the delay in the completion of the project or portion thereof. Accordingly, the parties agree, and by execution of this Agreement, Contractor acknowledges that it understands and agrees, that the amount(s) set forth herein as liquidated damages reflect the parties' best efforts at the time of entering into the Contract to estimate the damages that may be incurred by City and the public due to the Contractor's delay in completion of the Work and/or any specified portion thereof, and shall be presumed to be the amount of damages sustained by the failure of Contractor to complete the entire Work and/or any specified portion thereof within the time(s) specified herein.

B. Contractor shall pay liquidated damages to City for failure to complete the entire Work by the Completion Date (as extended in accordance with the Contract Documents, if applicable) in the amount of **one thousand five hundred dollars ($1,500.00) for each calendar day** after the Completion Date (as extended in accordance with the Contract Documents, if applicable), continuing to the time at which the entire Work is completed. Such amount is the actual cash value agreed upon by the City and Contractor as the loss to City and the public resulting from Contractor's default.

The parties agree, and by execution of this Agreement, Contractor acknowledges that it understands and agrees, that the foregoing provisions provide for the imposition of liquidated damages from the Completion Date (as extended in accordance with the Contract Documents, if applicable) until the date of completion of the entire Work as determined by the Engineer in accordance with Section 8-4 of the Standard Specifications, whether or not the Work or any portion thereof is claimed or determined to be substantially complete prior to such date of completion.

C. In the event Contractor shall become liable for liquidated damages, City, in addition to all other remedies provided by law, shall have the right to withhold any and all payments that otherwise would be or become due Contractor until the liability of Contractor under this section is finally determined. City shall have the right to use and apply such payments, in whole or in part, to reimburse City for all liquidated damages due or to become due to City. Any remaining balance of such payments shall be paid to Contractor only after discharge in full of all liability incurred by Contractor under this section or otherwise under any provision of the Contract Documents or any applicable Law or Regulation. If the sum so retained by City is not sufficient to discharge all such liabilities of Contractor, Contractor shall continue to remain liable to City until all such liabilities are satisfied in full. No failure by City to withhold any payment as specified above shall in any manner be construed to constitute a release of any such liabilities nor a waiver of the City's right to withhold payment for such liabilities.

16. INDEMNITY AND HOLD HARMLESS

A. Contractor shall defend, hold harmless and indemnify the City, its officers, employees, and agents, and each and every one of them, from and against any and all actions, damages, costs, liabilities, claims, demands, losses, judgments, penalties, costs and expenses of every type and description, whether arising on or off the site of the Work, including, but not limited to, any fees and/or costs reasonably incurred by City's staff attorneys or outside attorneys and any fees

and expenses incurred in enforcing this provision (hereafter collectively referred to as "Liabilities"), including but not limited to Liabilities arising from personal injury or death, damage to personal, real or intellectual property or the environment, contractual or other economic damages, or regulatory penalties, arising out of or in any way connected with performance of or failure to perform the Work by the Contractor, any subcontractor or agent, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, whether or not (i) such Liabilities are caused in part by a party indemnified hereunder, or (ii) such Liabilities are litigated, settled or reduced to judgment; provided that the foregoing indemnity does not apply to liability for damages for death or bodily injury to persons, injury to property, or other loss, damage or expense to the extent arising from (i) the sole negligence or willful misconduct of, or defects in design furnished by, City, its agents, servants, or independent contractors who are directly responsible to City, or (ii) the active negligence of City.

B. The existence or acceptance by City of any of the insurance policies or coverages described in this Agreement shall not affect or limit any of City's rights under this Section 16, nor shall the limits of such insurance limit the liability of Contractor hereunder. The provisions of this Section 16 shall survive any expiration or termination of the Contract.

17. CONTRACTOR SHALL ASSUME RISKS

Until the completion and final acceptance by City of all Work under this Contract, the Work shall be under Contractor's responsible care and charge, and Contractor, at no cost to City, shall rebuild, repair, restore and make good all injuries, damages, re-erections, and repairs occasioned or rendered necessary by accidental causes of any nature, to all or any portions of the Work.

18. GENERAL LIABILITY OF CONTRACTOR

Except as otherwise herein expressly stipulated, Contractor shall perform all the Work and furnish all the labor, materials, tools, equipment, apparatus, facilities, transportation, power and light, and appliances, necessary or proper for performing and completing the Work herein required in the manner and within the time herein specified. The mention of any specific duty or liability of Contractor shall not be construed as a limitation or restriction of any general liability or duty of Contractor, and any reference to any specific duty or liability shall be construed to be solely for the purpose of explanation.

19. INSURANCE

During the entire term of the Contract, Contractor shall maintain the insurance coverage described in this Section 19.

Full compensation for all premiums that Contractor is required to pay for the insurance coverage described herein shall be included in the compensation specified for the Work performed by Contractor under this Contract. No additional compensation will be provided for Contractor's insurance premiums. Any available insurance proceeds in excess of the specified minimum limits and coverages shall be available to the City.

It is understood and agreed by the Contractor that its liability to the City shall not in any way be limited to or affected by the amount of insurance coverage required or carried by the Contractor in connection with this Contract.

A. Minimum Scope & Limits of Insurance Coverage

(1) Commercial General Liability Insurance providing coverage at least as broad as ISO CGL Form 00 01 on an occurrence basis for bodily injury, including death, of one or more persons, property damage, and personal injury, arising out of activities performed

by or on behalf of Contractor and its subcontractors, products and completed operations of Contractor and its subcontractors, and premises owned, leased, or used by Contractor and its subcontractors, with limits of not less than one million dollars ($1,000,000) per occurrence. The policy shall provide contractual liability and products and completed operations coverage for the term of the policy.

(2) Automobile Liability Insurance providing coverage at least as broad as ISO Form CA 00 01 for bodily injury, including death, of one or more persons, property damage, and personal injury, with limits of not less than one million dollars ($1,000,000) per accident. The policy shall provide coverage for owned, non-owned, and/or hired autos as appropriate to the operations of the Contractor.

No automobile liability insurance shall be required if Contractor completes the following certification:

> "I certify that a motor vehicle will not be used in the performance of any work or services under this agreement." _____ (Contractor initials)

(3) Workers' Compensation Insurance with statutory limits, and Employers' Liability Insurance with limits of not less than one million dollars ($1,000,000). The Workers' Compensation policy shall include a waiver of subrogation in favor of the City.

No Workers' Compensation insurance shall be required if Contractor completes the following certification:

> "I certify that my business has no employees, and that I do not employ anyone. I am exempt from the legal requirements to provide Workers' Compensation insurance." _____ (Contractor initials)

B. Additional Insured Coverage

(1) Commercial General Liability Insurance: The City, its officials, employees, and volunteers and the Regional Water Authority (RWA) shall be covered by policy terms or endorsement as additional insureds as respects general liability arising out of: activities performed by or on behalf of Contractor and its subcontractors; products and completed operations of Contractor and its subcontractors; and premises owned, leased, or used by Contractor and its subcontractors.

(2) Automobile Liability Insurance: The City, its officials, employees, and volunteers shall be covered by policy terms or endorsement as additional insureds as respects auto liability.

C. Other Insurance Provisions

The policies are to contain, or be endorsed to contain, the following provisions:

(1) Contractor's insurance coverage, including excess insurance, shall be primary insurance as respects City, its officials, employees, and volunteers. Any insurance or self-insurance maintained by City, its officials, employees, or volunteers shall be in excess of Contractor's insurance and shall not contribute with it.

(2) Any failure to comply with reporting provisions of the policies shall not affect coverage provided to City, its officials, employees, or volunteers.

(3) Coverage shall state that Contractor's insurance shall apply separately to each insured

against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

(4) City will be provided with thirty (30) days written notice of cancellation or material change in the policy language or terms.

D. Acceptability of Insurance

Insurance shall be placed with insurers with a Bests' rating of not less than A:VI. Self-insured retentions, policy terms or other variations that do not comply with the requirements of this Section 3 must be declared to and approved by the City in writing prior to execution of this Contract.

E. Verification of Coverage

(1) Contractor shall furnish City and RWA with certificates and required endorsements evidencing the insurance required. The certificates and endorsements shall be forwarded to the City representative named in Exhibit A. Copies of policies shall be delivered to the City on demand. Certificates of insurance shall be signed by an authorized representative of the insurance carrier.

(2) For all insurance policy renewals during the term of this Contract, Contractor shall send insurance certificates reflecting the policy renewals directly to:

City of Sacramento
c/o Ebix RCS
Reference #: (This number will be provided by EBIX after Contract approval.)
151 North Lyon Street
Hemet, CA 92543

Insurance certificates also may be faxed to (770) 325-3340, or e-mailed to:
CertsOnly-Portland@ebix.com

(3) The City may withdraw its offer of contract or cancel this Contract if the certificates of insurance and endorsements required have not been provided prior to execution of this Contract. The City may withhold payments to Contractor or cancel the Contract if the insurance is canceled or Contractor otherwise ceases to be insured as required herein.

F. Subcontractors

Contractor shall require and verify that all subcontractors maintain insurance coverage that meets the minimum scope and limits of insurance coverage specified in subsection A, above.

20. FAILURE TO MAINTAIN BONDS OR INSURANCE

If, at any time during the performance of this Contract, Contractor fails to maintain any item of the bonds and/or insurance required under the Contract in full force and effect, Contractor shall immediately suspend all work under the Contract and notify City in writing of such failure. After such notice is provided, or if City discovers such failure and notifies Contractor, the City thereafter may withhold all Contract payments due or that become due until notice is received by City that such bonds and/or insurance have been restored in full force and effect and that the premiums therefor have been paid for a period satisfactory to the Division of Risk Management. Contractor shall not resume work until notified by City to do so, and the City shall have no responsibility or liability for any costs incurred by Contractor as a result of such suspension of Work.

In addition to the foregoing, any failure to maintain any item of the required bonds and/or insurance at any time during the performance of this Contract will be sufficient cause for termination of the Contract by City.

The Contractor shall be solely responsible for, and shall defend, indemnify and hold harmless the City, its officers, employees and agents against and from, any and all damages, claims, losses, actions, costs or other expenses of any kind incurred by any party as a direct or indirect result of any suspension of Work or termination of the Contract under the provisions of this Section.

21. EXCUSABLE DELAYS

For the purpose of these Contract Documents, the term "Excusable Delay" shall mean, and is limited to, delay caused directly by: acts of God; acts of a public enemy; fires; inclement weather as determined by the Engineer; riots; insurrections; epidemics; quarantine restrictions; strikes; lockouts; sitdowns; acts of a governmental agency; priorities or privileges established for the manufacture, assemble, or allotment of materials necessary in the Work by order, decree or otherwise of the United States or by any department, bureau, commission, committee, agent, or administrator of any legally constituted public authority; changes in the Work ordered by City insofar as they necessarily require additional time in which to complete the Work; the prevention of Contractor from commencing or prosecuting the Work because of the acts of others, excepting Contractor's subcontractors or suppliers; or the prevention of Contractor from commencing or prosecuting the Work because of a Citywide failure of public utility service.

The term "Excusable Delay" shall specifically <u>not</u> include: (i) any delay that could have been avoided by the exercise of care, prudence, foresight and diligence on the part of Contractor; (ii) any delay in the prosecution of any part of the Work that does not constitute a Controlling Operation, whether or not such delay is unavoidable; (iii) any reasonable delay resulting from time required by City for review of any Contractor submittals and for the making of surveys, measurements and inspection; and, (iv) any delay arising from an interruption in the prosecution of the Work on account of reasonable interference by other Contractors employed by City that does not necessarily prevent the completion of the entire Work within the time specified. Excusable Delays, if any, shall operate only to extend the Completion Date (not in excess of the period of such delay as determined by City) and shall not under any circumstances increase the amount City is required to pay Contractor except as otherwise provided in these Contract Documents.

22. CONTRACTOR TO SERVE NOTICE OF DELAYS

Whenever Contractor foresees any delay in the prosecution of the Work, and in any event as soon as possible (not to exceed a period of ten (10) calendar days) after the initial occurrence of any delay that Contractor regards as or may later claim to be an Excusable Delay, the Contractor shall notify the Engineer in writing of such delay and its cause, in order that the Engineer: (i) may take immediate steps to prevent if possible the occurrence or continuance of the delay; or (ii) if this cannot be done, may determine whether the delay is to be considered excusable, how long it continues, and to what extent the prosecution and completion of the Work are delayed thereby. Said written notice shall constitute an application for an extension of time only if the notice requests such an extension and sets forth the Contractor's estimate of the additional time required together with a full description of the cause of the delay relied upon.

After the completion of any part or whole of the Work, the Engineer, in estimating the amount due Contractor, will assume that any and all delays that may have occurred in its prosecution and completion were not Excusable Delays, except for such delays for which the Contractor has provided timely written notice as required herein, and that the Engineer has found to be excusable. Contractor shall not be entitled to claim Excusable Delay for any delay for which the Contractor failed to provide such timely written notice.

23. EXTENSION OF TIME

If the Contractor complies with Section 22, above, and the Engineer finds a delay claimed by the Contractor to be an Excusable Delay, the Contractor shall be allowed an extension of time to complete the Work that is proportional to the period of Excusable Delay determined by the Engineer, subject to the approval by City

of a change order granting such time extension. During a duly authorized extension for an Excusable Delay, City shall not charge liquidated damages against the Contractor for such delay.

If the City extends the time to complete the Work as provided herein, such extension shall in no way release any warranty or guarantee given by Contractor pursuant to the provisions of the Contract Documents, nor shall such extension of time relieve or release the sureties of the Bonds provided pursuant to the Contract Documents. By executing such Bonds, the Sureties shall be deemed to have expressly agreed to any such extension of time. The granting of any extension of time as provided herein shall in no way operate as a waiver on the part of City of its rights under this Contract, excepting only extension of the Completion Date for such period of Excusable Delay as may be determined by the Engineer and approved by a duly authorized change order.

24. NO PAYMENT FOR DELAYS

No damages or compensation of any kind shall be paid to Contractor or any subcontractor because of delays in the progress of the Work whether or not such delays qualify for extension of time under this Agreement; except that this provision shall not preclude the recovery of damages for a delay caused by the City that is unreasonable under the circumstances and that is not within the contemplation of the parties, provided that the Contractor timely submits all such written notice(s) and fully complies with such other procedures as may be specified in the Contract Documents or any Laws or Regulations for Contractor to claim damages for such delay.

25. CHANGES IN THE WORK

Changes in the Work authorized or directed in accordance with the Contract Documents and extensions of time of completion made necessary by reason thereof shall not in any way release any warranty or guarantee given by Contractor pursuant to the provisions of the Contract Documents, nor shall such changes in the Work relieve or release the Sureties on Bonds provided pursuant to the Contract Documents. By executing such Bonds, the Sureties shall be deemed to have expressly agreed to any such change in Work and to any extension of time made by reason thereof.

26. TERMINATION AFTER COMPLETION DATE

In addition to any other rights City may have, if any services or work required under the Contract (including but not limited to punch list items) are not completed as of the Completion Date (as adjusted by any extensions of time for Excusable Delays granted pursuant to the Contract Documents), City may terminate the Contract at any time after the Completion Date (as adjusted by any extensions of time for Excusable Delays granted pursuant to the Contract Documents), by providing a written notice to Contractor specifying the date of termination. Such notice also may specify conditions or requirements that Contractor must meet to avoid termination of the Contract on such date. If Contractor fails to fulfill all such conditions and requirements by such termination date, or, if no such conditions or requirements are specified, Contractor shall cease rendering services and performing work on such termination date, and shall not be entitled to receive any compensation for services rendered or work performed after such termination date. In the event of such termination, Contractor shall remain liable to City for liquidated damages incurred for any period of time prior to the termination date.

In addition to any other charges, withholdings or deductions authorized under the Contract or any Laws or Regulations, if City terminates the Contract pursuant to this section, City may withhold and deduct from any payment and/or retention funds otherwise due Contractor any sum necessary to pay the City's cost of completing or correcting, or contracting for the completion or correction of, any services or work under the Contract that are not completed to the satisfaction of the City or that otherwise are deficient or require correction as of such termination date, including but not limited to incomplete punch list items. Such costs shall include all of the City’s direct and indirect costs incurred to complete or correct such services or work, including the City’s administrative and overhead costs. If the amount of payment(s) and/or retention funds otherwise due the Contractor are insufficient to pay such costs, City shall have the right to recover the balance of such costs from the Contractor and/or its Surety(ies).

27. TERMINATION FOR CONVENIENCE

Upon written notice to the Contractor, the City may at any time, without cause and without prejudice to any other right or remedy of the City, elect to terminate the Contract for the convenience of City. In such case, the Contractor shall be paid (without duplication of any items, and after deduction and/or withholding of any amounts authorized to be deducted or withheld by the Contract Documents or any Laws or Regulations):

A. For Work executed in accordance with the Contract Documents prior to the effective date of termination and determined to be acceptable by the Engineer, including fair and reasonable sums for overhead and profit on such Work;

B. For reasonable claims, costs, losses, and damages incurred in settlement of terminated contracts with subcontractors, suppliers, and others; and

C. For reasonable expenses directly attributable to termination.

Contractor shall not be paid for any loss of anticipated profits or revenue for any Work not performed prior to termination, nor for any economic loss arising out of or resulting from such termination, except for the payments listed in this section. Contractor's warranty under Section 14 of this Agreement shall apply, and Contractor shall remain responsible for all obligations related to such warranty, with respect to all portions of the Work performed prior to the effective date of the termination for convenience pursuant to this section. The City shall be entitled to have any or all remaining Work performed by other contractors or by any other means at any time after the effective date of a termination for convenience pursuant to this section.

28. TERMINATION FOR BREACH OF CONTRACT

If Contractor abandons the Work under this Contract, or if the Contract or any portion of the Contract is sublet or assigned without the consent of the City, or if the Engineer determines in the Engineer's sole discretion that the conditions of the Contract in respect to the rate of progress of the Work are not being fulfilled or any part thereof is unnecessarily delayed, or if Contractor violates or breaches, or fails to execute in good faith, any of the terms or conditions of the Contract, or if Contractor refuses or fails to supply enough properly skilled labor or materials or refuses or fails to make prompt payment to subcontractors for material or labor, or if Contractor disregards any Laws or Regulations or proper instruction or orders of the Engineer, then, notwithstanding any provision to the contrary herein, the City may give Contractor and its Sureties written notification to immediately correct the situation or the Contract shall be terminated.

In the event that such notice is given, and, in the event such situation is not corrected, or arrangements for correction satisfactory to the City are not made, within ten (10) calendar days from the date of such notice or within such other period of time as may be specified by the City in the notice, the Contract shall upon the expiration of said period cease and terminate. In the event of any such termination, City may take over the Work and prosecute the Work to completion, or otherwise, and the Contractor and its Sureties shall be liable to City for any cost occasioned City thereby, as hereinafter set forth.

In the event City completes the Work, or causes the Work to be completed, no payment of any kind shall be made to Contractor until the Work is complete. The cost of completing the Work, including but not limited to, extra costs of project administration and management incurred by City, both direct or indirect, shall be deducted from any sum then due, or that becomes due, to Contractor from City. If sums due to Contractor from City are less than the cost of completing the Work, Contractor and its Sureties shall pay City a sum equal to this difference on demand. In the event City completes the Work, and there is a sum remaining due to Contractor after City deducts the costs of completing the Work, then City shall pay such sum to Contractor. The Contractor and Contractor's Sureties shall be jointly and severally liable for all obligations imposed on Contractor hereunder.

No act by City before the Work is finally accepted, including, but not limited to, exercise of other rights under the Contract, actions at law or in equity, extensions of time, payments, assessments of liquidated

damages, occupation or acceptance of any part of the Work, waiver of any prior breach of the Contract or failure to take action pursuant to this section upon the happening of any prior default or breach of Contractor, shall be construed to be a waiver or estoppel of the City's right to act pursuant to this Section upon any subsequent event, occurrence or failure by Contractor to fulfill the terms and conditions of the Contract. The rights of City to terminate the Contract pursuant to this Section and pursuant to Sections 26 and 27 are cumulative and are in addition to all other rights of City pursuant to the Contract and at law or in equity.

29. CONTRACTOR BANKRUPT

If Contractor should commence any bankruptcy proceeding, or if Contractor is adjudged a bankrupt, or if Contractor makes any assignment for the benefit of creditors, or if a receiver is appointed on account of Contractor's insolvency, then the City may, without prejudice to any other right or remedy, terminate the Contract and complete the work by giving notice as provided in Section 28 above.

30. SURETIES' OBLIGATIONS UPON TERMINATION

If the City terminates the Contract pursuant to Section 28 or Section 29 above:

A. The Surety under Contractor's performance bond shall be fully responsible for all of the Contractor's remaining obligations of performance under the Contract as if the Surety were a party to the Contract, including without limitation Contractor's obligations, as provided in the Contract Documents, to complete and provide a one-year warranty of the entire Work, pay liquidated damages and indemnify, defend and hold harmless City, up to the full amount of the performance bond.

B. The Surety under Contractor's payment bond shall be fully responsible for the performance of all of the Contractor's remaining payment obligations for work, services, equipment or materials performed or provided in connection with the Work or any portion thereof, up to the full amount of the payment bond.

31. ACCOUNTING RECORDS OF CONTRACTOR

During performance of the Contract and for a period of three (3) years after completing the entire Work, Contractor shall maintain all accounting and financial records related to the Contract and performance of the Work in accordance with generally accepted accounting practices, and shall keep and make such records available for inspection and audit by representatives of the City upon reasonable written notice.

32. USE TAX REQUIREMENTS

During the performance of this Agreement, CONTRACTOR, for itself, its assignees and successors in interest, agrees as follows:

A. Use Tax Direct Payment Permit: For all leases and purchases of materials, equipment, supplies, or other tangible personal property used to perform the Agreement and shipped from outside California, the Contractor and any subcontractors leasing or purchasing such materials, equipment, supplies or other tangible personal property shall obtain a Use Tax Direct Payment Permit from the California State Board of Equalization ("SBE") in accordance with the applicable SBE criteria and requirements.

B. Sellers Permit: For any construction contract and any construction subcontract in the amount of $5,000,000 or more, Contractor and the subcontractor(s) shall obtain sellers permits from the SBE and shall register the jobsite as the place of business for the purpose of allocating local sales and use tax to the City. Contractor and its subcontractors shall remit the self-accrued use tax to the SBE, and shall provide a copy of each remittance to the City.

C. The above provisions shall apply in all instances unless prohibited by the funding source for the Agreement.

IN WITNESS WHEREOF, the parties hereto have signed this Agreement on the date set for opposite their names.

CONTRACTOR

Under penalty of perjury, I certify that the taxpayer identification number and all other information provided here are correct.

Date: 8/10/16

By: _____

Kip Skidmore
Print Name

President
Title

By: _____

Print Name

Title

68-0039679
Federal ID#

31691181
State ID#

101851
City of Sacramento Business Operation Tax Certificate No. (City will not award contract until Certificate Number is obtained)

Type of Business Entity *(check one)*:
_____ Individual/Sole Proprietor
_____ Partnership
__x__ Corporation
_____ Limited Liability Company
_____ Other (please specify:_____)

CITY OF SACRAMENTO
a municipal corporation

DATE_____

By: _____
For: John F. Shirey, City Manager

Original Approved As To Form:

_____
City Attorney

Attest:

_____
City Clerk

Form approved by City Attorney 12-24-14

CITY OF SACRAMENTO
PERFORMANCE BOND
Department of Utilities

Bond No.: 9828550
Premium: $81,192.00

WHEREAS, the City of Sacramento, State of California, hereinafter called City, has conditionally awarded to

Sierra National Construction, Inc.
5433 El Camino Ave, Ste 4
Carmichael, Ca 95608

as principal, hereinafter called Contractor, a contract for construction of:

Shasta Park Water Facility
(PN: Z14005402) (B16141321030)

which contract is by reference incorporated herein and made a part hereof as if the Surety named below were a party to the contract, and is hereinafter referred to as the Contract; and

WHEREAS, under the terms of the Contract, Contractor is required to furnish a bond for the faithful performance of the Contract.

NOW, THEREFORE, we the Contractor and *(here insert full name and address of Surety)*: Great American Insurance Company, 301 E. 4th St., Cincinnati, Ohio 45202, a corporation duly authorized and admitted to transact business and issue surety bonds in the State of California, hereinafter called Surety, are held and firmly bound unto the City, as oblige, in the sum of: **Eleven Million Five Hundred Ninety Five Thousand Seven Hundred Ninety ($11,595,790.00)** for the payment of which sum well and truly to be made, we the Contractor and Surety bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally. The condition of this obligation is such that, if the Contractor, Contractor's heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and fully perform all covenants, conditions and agreements required to be kept and performed by Contractor in the Contract and any changes, additions or alterations made thereto, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meanings, and shall indemnify and save harmless the City, its officers, employees and agents, as therein provided, then the Surety's obligations under the Contract and this bond shall be null and void; otherwise they shall be and remain in full force and effect. This obligation shall remain in full force and effect through the end of the Contract warranty period, which will expire one year after the completion of work date specified in the Notice of Completion filed for the above-named project.

As part of the obligations secured hereby and in addition to the sum specified above there shall be included all costs, expenses and fees, including attorney's fees, reasonably incurred by City in successfully enforcing such obligations, all to be taxed as costs and included in any judgment rendered.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or to the specifications accompanying the same shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension, alteration or addition.

IN WITNESS WHEREOF, this instrument has been duly executed by authorized representatives of the Contractor and Surety. SIGNED AND SEALED on Aug. 9, 2016.

Sierra National Construction, Inc.
(Contractor) (Seal)
By:
Title: Kip Skidmore, President

ORIGINAL APPROVED AS TO FORM:
City Attorney

Great American Insurance Company
(Surety) (Seal)
By
Title James D. Einerson, Attorney-in-Fact
Agent Name and Address: James D. Einerson
11350 Huntington Village Lane, Gold River, CA 95670
Agent Phone #: 916-631-7987
Surety Phone #: 513-369-5000
California License # 0796662
Surety Email: wwilson@gaic.com

CITY OF SACRAMENTO
PAYMENT BOND
Department of Utilities

Bond No.: 9828550
Premium: Included in Performance Bond

WHEREAS, the City of Sacramento, in the State of California, hereinafter called City, has conditionally awarded to:

Sierra National Construction, Inc.
5433 El Camino Ave, Ste 4
Carmichael, Ca 95608

hereinafter called Contractor, a contract for construction of:

Shasta Park Water Facility
(PN: Z14005402) (B16141321030)

Which contract is by reference incorporated herein and made a part hereof, and is hereinafter referred to as the Contract; and

WHEREAS, under the terms of the Contract and pursuant to Chapter 5 of Title 3 of Part 6 of Division 4 of the California Civil Code (commencing with Civil Code Section 9550), Contractor is required to furnish a good and sufficient payment bond to secure payment of the claims to which reference is made in Civil Code Section 9554.

NOW, THEREFORE, we the Contractor and (*here insert full name and address of Surety*): Great American Insurance Company 301 E. 4th Street, Cincinnati, OH 45202, a corporation duly authorized and admitted to transact business and issue surety bonds in the State of California, hereinafter called Surety, are held and firmly bound unto the City, and unto all persons or entities entitled to assert a claim against a payment bond under any of the aforesaid Civil Code provisions in the sum of **Eleven Million Five Hundred Ninety Five Thousand Seven Hundred Ninety ($11,595,790.00)** on the condition that if Contractor shall fail to pay for any materials or equipment furnished or used in performance of the Contract, or for any work or labor thereon of any kind, or for amounts due under the Unemployment Insurance Act with respect to such work or labor, or for any amounts required to be deducted, withheld, and paid over to the Franchise Tax Board or the Employment Development Department from the wages of employees of the Contractor and all subcontractors with respect to such work or labor, then the Surety shall pay the same in an amount not exceeding the sum specified above. If suit is brought upon this bond, Surety shall pay, in addition to the above sum, all costs, expenses and fees, including attorney's fees, reasonably incurred by any party in successfully enforcing the obligation secured hereby, all to be taxed as costs and included in any judgment rendered. Should the condition of this bond be fully performed, then this obligation shall become null and void, otherwise it shall be and remain in full force and effect, and shall bind Contractor, Surety, their heirs, executors, administrators, successors and assigns, jointly and severally.

It is hereby stipulated and agreed that this bond shall inure to the benefit of all persons, companies, corporations, political subdivisions, State agencies and other entities entitled to assert a claim against a payment bond under any of the aforesaid Civil Code provisions, so as to give a right of action to them or their assigns in any suit brought upon this bond. The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or to the specifications accompanying the same shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension, alteration or addition.

IN WITNESS WHEREOF, this instrument has been duly executed by authorized representatives of the Contractor and Surety. SIGNED AND SEALED on August 9, 2016.

Sierra National Construction, Inc.
(Contractor) (Seal)
By:
Title: Kip Skidmore, President

ORIGINAL APPROVED AS TO FORM:

City Attorney

Great American Insurance Company
(Surety) (Seal)
By
Title James D. Einerson, Attorney-in-Fact
Agent Name and Address: James D. Einerson
11350 Huntington Village Lane, Gold River, CA 95670
Agent Phone #: 916-631-7987
Surety Phone #: 513-369-5000
California License # 0796662
Surety Email: wwilson@gaic.com

Effective 7-1-12

CITY OF SACRAMENTO **Bond #:_____**
PERFORMANCE BOND **Premium: _____**
Department of Utilities

WHEREAS, the City of Sacramento, in the State of California, hereinafter called City has conditionally awarded to (*here insert full name and address of Contractor)*:

as principal, hereinafter called Contractor, an agreement for construction of:

SHASTA PARK WATER FACILITY
(PN: Z14005402) (B16141321030)

in accordance with the plans, specifications, drawings, conditions, and project manual prepared therefore, which agreement is by reference made a part hereof, and is hereinafter referred to as the Contract; and

WHEREAS, under the terms of the Contract, Contractor is required to furnish a bond for the faithful performance of the Contract.

NOW, THEREFORE, we the Contractor and (*here insert full name and address of Surety*):

_____, a corporation duly authorized and admitted to transact business and issue surety bonds in the State of California, hereinafter called Surety, are held and firmly bound unto the City, as obligee, in the sum of _____DOLLARS $_____), for the payment of which sum well and truly to be made, we the Contractor and Surety bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally. The condition of this obligation is such that, if the Contractor, Contractor's heirs, executors, administrators, successors, or assigns, shall in all things stand to and abide by, and well and truly keep and fully perform all covenants, conditions and agreements required to be kept and performed by Contractor in the Contract and any changes, additions or alterations made thereto, to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meanings, and shall indemnify and save harmless the City, its officers, employees and agents, as therein provided, then this obligation shall be null and void; otherwise shall be and remain in full force and effect. This obligation shall remain in full force and effect until (1) the date that the Contractor no longer has any remaining obligation of performance under the Contract, or (2) the date that is one year after the date that the work to be performed under the Contract is accepted as complete by the City, whichever occurs later.

As part of the obligation secured hereby and in addition to the sum specified above, there shall be included all costs, expenses and fees, including attorney's fees, reasonably incurred by City in successfully enforcing such obligation, all to be taxed as costs and included in any judgement rendered.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract, or to the work to be performed thereunder, or to the specifications accompanying the same, shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension, alteration or addition.

IN WITNESS WHEREOF, this instrument has been duly executed by authorized representatives of the Contractor and Surety.
SIGNED AND SEALED on _____, 2016.

_____
(Contractor) (Seal)

By _____

Title _____

ORIGINAL APPROVED AS TO FORM:

_____
City Attorney

_____
(Surety) (Seal)

By _____

Title _____
Agent Name and Address _____

_____
Agent Phone # _____
Surety Phone # _____
California License # _____
Surety Email: _____

CITY OF SACRAMENTO
PAYMENT BOND
Department of Utilities

Bond No: _____
Premium: _____

WHEREAS, the City of Sacramento, in the State of California, hereinafter called City, has conditionally awarded to:

hereinafter called Contractor, a contract for construction of:

SHASTA PARK WATER FACILITY
(PN: Z14005402) (B16141321030)

Which contract is by reference incorporated herein and made a part hereof, and is hereinafter referred to as the Contract; and

WHEREAS, under the terms of the Contract and pursuant to Chapter 5 of Title 3 of Part 6 of Division 4 of the California Civil Code (commencing with Civil Code Section 9550), Contractor is required to furnish a good and sufficient payment bond to secure payment of the claims to which reference is made in Civil Code Section 9554.

NOW, THEREFORE, we the Contractor and (*here insert full name and address of Surety*):

_____ , a corporation a corporation duly authorized and admitted to transact business and issue surety bonds in the State of California, hereinafter called Surety, are held and firmly bound unto the City, and unto all persons or entities entitled to assert a claim against a payment bond under any of the aforesaid Civil Code provisions in the sum of _____DOLLARS ($_____), on the condition that if Contractor shall fail to pay for any materials or equipment furnished or used in performance of the Contract, or for any work or labor thereon of any kind, or for amounts due under the Unemployment Insurance Act with respect to such work or labor, or for any amounts required to be deducted, withheld, and paid over to the Franchise Tax Board or the Employment Development Department from the wages of employees of the Contractor and all subcontractors with respect to such work or labor, then the Surety shall pay the same in an amount not exceeding the sum specified above. If suit is brought upon this bond, Surety shall pay, in addition to the above sum, all costs, expenses and fees, including attorney's fees, reasonably incurred by any party in successfully enforcing the obligation secured hereby, all to be taxed as costs and included in any judgment rendered. Should the condition of this bond be fully performed, then this obligation shall become null and void, otherwise it shall be and remain in full force and effect, and shall bind Contractor, Surety, their heirs, executors, administrators, successors and assigns, jointly and severally.

It is hereby stipulated and agreed that this bond shall inure to the benefit of all persons, companies, corporations, political subdivisions, State agencies and other entities entitled to assert a claim against a payment bond under any of the aforesaid Civil Code provisions, so as to give a right of action to them or their assigns in any suit brought upon this bond. The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract or to the work to be performed thereunder or to the specifications accompanying the same shall in any way affect its obligations on this bond, and it does hereby waive notice of any such change, extension, alteration or addition.

IN WITNESS WHEREOF, this instrument has been duly executed by authorized representatives of the Contractor and Surety.
SIGNED AND SEALED on _____ 2016.

_____
(Contractor) (Seal)

By _____

Title _____

ORIGINAL APPROVED AS TO FORM:

_____
City Attorney

_____
(Surety) (Seal)

By _____

Title _____
Agent Name and Address _____

_____
Agent Phone # _____
Surety Phone # _____
California License # _____
Surety Email: _____

Effective 7-1-12

ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of Sacramento)

On 8/9/16 before me, Gail C. Einerson, Notary Public
(insert name and title of the officer)

personally appeared James D. Einerson,
who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature Gail C. Einerson (Seal)

GAIL C. EINERSON
COMM. #2143976
Notary Public-California
SACRAMENTO COUNTY
My Comm. Exp. MAR. 21, 2020

CALIFORONIA LABOR CODE RELATING TO APPRENTICES ON PUBLIC WORKS PROJECTS

See following links: www.dir.ca.gov and/or www.leginfo.ca.gov

http://www.dir.ca.gov/dlse/dlsePublicWorks.html

GREAT AMERICAN INSURANCE COMPANY®

Administrative Office: 301 E 4TH STREET • CINCINNATI, OHIO 45202 • 513-369-5000 • FAX 513-723-2740

The number of persons authorized by
this power of attorney is not more than THREE

No. 0 14660

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the GREAT AMERICAN INSURANCE COMPANY, a corporation organized and existing under and by virtue of the laws of the State of Ohio, does hereby nominate, constitute and appoint the person or persons named below, each individually if more than one is named, its true and lawful attorney-in-fact, for it and in its name, place and stead to execute on behalf of the said Company, as surety, any and all bonds, undertakings and contracts of suretyship, or other written obligations in the nature thereof; provided that the liability of the said Company on any such bond, undertaking or contract of suretyship executed under this authority shall not exceed the limit stated below.

Name	Address	Limit of Power
JAMES D. EINERSON	ALL OF	ALL
GAIL C. EINERSON	GOLD RIVER,	$100,000,000.00
MICHELLE FURNO	CALIFORNIA	

This Power of Attorney revokes all previous powers issued on behalf of the attorney(s)-in-fact named above.

IN WITNESS WHEREOF the GREAT AMERICAN INSURANCE COMPANY has caused these presents to be signed and attested by its appropriate officers and its corporate seal hereunto affixed this 16TH day of SEPTEMBER, 2015.

Attest

GREAT AMERICAN INSURANCE COMPANY

Assistant Secretary

Divisional Senior Vice President

STATE OF OHIO, COUNTY OF HAMILTON - ss:

DAVID C. KITCHIN (877-377-2405)

On this 16TH day of SEPTEMBER, 2015, before me personally appeared DAVID C. KITCHIN, to me known, being duly sworn, deposes and says that he resides in Cincinnati, Ohio, that he is a Divisional Senior Vice President of the Bond Division of Great American Insurance Company, the Company described in and which executed the above instrument; that he knows the seal of the said Company; that the seal affixed to the said instrument is such corporate seal; that it was so affixed by authority of his office under the By-Laws of said Company, and that he signed his name thereto by like authority.

Susan A. Kohorst
Notary Public, State of Ohio
My Commission Expires 05-18-2020

This Power of Attorney is granted by authority of the following resolutions adopted by the Board of Directors of Great American Insurance Company by unanimous written consent dated June 9, 2008.

RESOLVED: That the Divisional President, the several Divisional Senior Vice Presidents, Divisional Vice Presidents and Divisonal Assistant Vice Presidents, or any one of them, be and hereby is authorized, from time to time, to appoint one or more Attorneys-in-Fact to execute on behalf of the Company, as surety, any and all bonds, undertakings and contracts of suretyship, or other written obligations in the nature thereof; to prescribe their respective duties and the respective limits of their authority; and to revoke any such appointment at any time.

RESOLVED FURTHER: That the Company seal and the signature of any of the aforesaid officers and any Secretary or Assistant Secretary of the Company may be affixed by facsimile to any power of attorney or certificate of either given for the execution of any bond, undertaking, contract of suretyship, or other written obligation in the nature thereof, such signature and seal when so used being hereby adopted by the Company as the original signature of such officer and the original seal of the Company, to be valid and binding upon the Company with the same force and effect as though manually affixed.

CERTIFICATION

I, STEPHEN C. BERAHA, Assistant Secretary of Great American Insurance Company, do hereby certify that the foregoing Power of Attorney and the Resolutions of the Board of Directors of June 9, 2008 have not been revoked and are now in full force and effect.

Signed and sealed this 9 day of Aug., 2011.

Assistant Secretary

S1029AF (06/15)

Form **W-9**
(Rev. December 2014)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Give Form to the requester. Do not send to the IRS.

Print or type
See Specific Instructions on page 2.

1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.

2 Business name/disregarded entity name, if different from above
Sierra National Construction, Inc.

3 Check appropriate box for federal tax classification; check only one of the following seven boxes:
☐ Individual/sole proprietor or single-member LLC ☑ C Corporation ☐ S Corporation ☐ Partnership ☐ Trust/estate
☐ Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=partnership) ▶
Note. For a single-member LLC that is disregarded, do not check LLC; check the appropriate box in the line above for the tax classification of the single-member owner.
☐ Other (see instructions) ▶

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):
Exempt payee code (if any)
Exemption from FATCA reporting code (if any)
(Applies to accounts maintained outside the U.S.)

5 Address (number, street, and apt. or suite no.)
5433 El Camino Avenue, Suite 4

Requester's name and address (optional)

6 City, state, and ZIP code
Carmichael, CA 95608

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN* on page 3.

Note. If the account is in more than one name, see the instructions for line 1 and the chart on page 4 for guidelines on whose number to enter.

Social security number
☐☐☐ – ☐☐ – ☐☐☐☐

or

Employer identification number
6 8 – 0 0 3 9 6 7 9

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions on page 3.

Sign Here Signature of U.S. person ▶ Date ▶ 3/1/16

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. Information about developments affecting Form W-9 (such as legislation enacted after we release it) is at *www.irs.gov/fw9*.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following:

- Form 1099-INT (interest earned or paid)
- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See *What is backup withholding?* on page 2.

By signing the filled-out form, you:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),
2. Certify that you are not subject to backup withholding, or
3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income, and
4. Certify that FATCA code(s) entered on this form (if any) indicating that you are exempt from the FATCA reporting, is correct. See *What is FATCA reporting?* on page 2 for further information.

TAXABLE YEAR

CALIFORNIA FORM

2016 Withholding Exemption Certificate 590

The payee completes this form and submits it to the withholding agent. The withholding agent keeps this form with their records.

Withholding Agent

Name

City of Sacramento

Payee

Name

Sierra National Construction, Inc.

☐ SSN or ITIN ☑ FEIN ☐ CA Corp no. ☐ CA SOS file no.

6 8 - 0 0 3 9 6 7 9

Address (apt./ste., room, PO box, or PMB no.)

5433 El Camino Ave Suite 4

City (If you have a foreign address, see instructions.)

Carmichael

State: CA

ZIP code: 95608

Exemption Reason

Check only one reason box below that applies to the payee.

By checking the appropriate box below, the payee certifies the reason for the exemption from the California income tax withholding requirements on payment(s) made to the entity or individual.

☐ **Individuals — Certification of Residency:**
I am a resident of California and I reside at the address shown above. If I become a nonresident at any time, I will promptly notify the withholding agent. See instructions for General Information D, Definitions.

☑ **Corporations:**
The corporation has a permanent place of business in California at the address shown above or is qualified through the California Secretary of State (SOS) to do business in California. The corporation will file a California tax return. If this corporation ceases to have a permanent place of business in California or ceases to do any of the above, I will promptly notify the withholding agent. See instructions for General Information D, Definitions.

☐ **Partnerships or Limited Liability Companies (LLCs):**
The partnership or LLC has a permanent place of business in California at the address shown above or is registered with the California SOS, and is subject to the laws of California. The partnership or LLC will file a California tax return. If the partnership or LLC ceases to do any of the above, I will promptly inform the withholding agent. For withholding purposes, a limited liability partnership (LLP) is treated like any other partnership.

☐ **Tax-Exempt Entities:**
The entity is exempt from tax under California Revenue and Taxation Code (R&TC) Section 23701 _____ (insert letter) or Internal Revenue Code Section 501(c) _____ (insert number). If this entity ceases to be exempt from tax, I will promptly notify the withholding agent. Individuals cannot be tax-exempt entities.

☐ **Insurance Companies, Individual Retirement Arrangements (IRAs), or Qualified Pension/Profit-Sharing Plans:**
The entity is an insurance company, IRA, or a federally qualified pension or profit-sharing plan.

☐ **California Trusts:**
At least one trustee and one noncontingent beneficiary of the above-named trust is a California resident. The trust will file a California fiduciary tax return. If the trustee or noncontingent beneficiary becomes a nonresident at any time, I will promptly notify the withholding agent.

☐ **Estates — Certification of Residency of Deceased Person:**
I am the executor of the above-named person's estate or trust. The decedent was a California resident at the time of death. The estate will file a California fiduciary tax return.

☐ **Nonmilitary Spouse of a Military Servicemember:**
I am a nonmilitary spouse of a military servicemember and I meet the Military Spouse Residency Relief Act (MSRRA) requirements. See instructions for General Information E, MSRRA.

CERTIFICATE OF PAYEE: Payee must complete and sign below.

To learn about your privacy rights, how we may use your information, and the consequences for not providing the requested information, go to **ftb.ca.gov** and search for **privacy notice**. To request this notice by mail, call 800.852.5711.

Under penalties of perjury, I hereby certify that the information provided in this document is, to the best of my knowledge, true and correct. If conditions change, I will promptly notify the withholding agent.

Type or print payee's name and title Kip Skidmore

Telephone (916) 481-6792

Payee's signature ▶

Date 8/10/16

7061163

Form 590 C2 2015

101851

101851

SACRAMENTO

BUSINESS OPERATIONS TAX CERTIFICATE

		FROM Mo. Day Yr.	TO Mo. Day Yr.
Business Name	SIERRA NATIONAL CONSTRUCTIO		
Business Address	5433 EL CAMINO AVE 4		
Owner	KIP S SKIDMORE	07/01/2016	06/30/2017
Type of Business	CONTRACTOR		
Tax Classification	401		Expires

CITY OF SACRAMENTO

JUN 2 5 2016

PAID

TOTAL PAID: $31.01

SIERRA NATIONAL CONSTRUCTION
5433 EL CAMINO AVE 4
CARMICHAEL, CA 95608

VOID IF NOT VALIDATED

THIS STUB MAY BE FOLDED/DETACHED BEFORE POSTING

This certificate is not to be construed as a business license or imply that the City of Sacramento has investigated, or approves or recommends, the holder of this certificate. Any representation to the contrary is fraudulent. (This certificate must be renewed within 30 days of expiration).

Form **W-9**
(Rev. December 2014)
Department of the Treasury
Internal Revenue Service

Request for Taxpayer Identification Number and Certification

Give Form to the requester. Do not send to the IRS.

Print or type
See Specific Instructions on page 2.

1 Name (as shown on your income tax return). Name is required on this line; do not leave this line blank.

2 Business name/disregarded entity name, if different from above

3 Check appropriate box for federal tax classification; check only **one** of the following seven boxes:
☐ Individual/sole proprietor or single-member LLC ☐ C Corporation ☐ S Corporation ☐ Partnership ☐ Trust/estate
☐ Limited liability company. Enter the tax classification (C=C corporation, S=S corporation, P=partnership) ▶
Note. For a single-member LLC that is disregarded, do not check LLC; check the appropriate box in the line above for the tax classification of the single-member owner.
☐ Other (see instructions) ▶

4 Exemptions (codes apply only to certain entities, not individuals; see instructions on page 3):
Exempt payee code (if any)
Exemption from FATCA reporting code (if any)
(Applies to accounts maintained outside the U.S.)

5 Address (number, street, and apt. or suite no.)

Requester's name and address (optional)

6 City, state, and ZIP code

7 List account number(s) here (optional)

Part I Taxpayer Identification Number (TIN)

Enter your TIN in the appropriate box. The TIN provided must match the name given on line 1 to avoid backup withholding. For individuals, this is generally your social security number (SSN). However, for a resident alien, sole proprietor, or disregarded entity, see the Part I instructions on page 3. For other entities, it is your employer identification number (EIN). If you do not have a number, see *How to get a TIN* on page 3.

Note. If the account is in more than one name, see the instructions for line 1 and the chart on page 4 for guidelines on whose number to enter.

Social security number
☐☐☐ – ☐☐ – ☐☐☐☐

or

Employer identification number
☐☐ – ☐☐☐☐☐☐☐

Part II Certification

Under penalties of perjury, I certify that:

1. The number shown on this form is my correct taxpayer identification number (or I am waiting for a number to be issued to me); and
2. I am not subject to backup withholding because: (a) I am exempt from backup withholding, or (b) I have not been notified by the Internal Revenue Service (IRS) that I am subject to backup withholding as a result of a failure to report all interest or dividends, or (c) the IRS has notified me that I am no longer subject to backup withholding; and
3. I am a U.S. citizen or other U.S. person (defined below); and
4. The FATCA code(s) entered on this form (if any) indicating that I am exempt from FATCA reporting is correct.

Certification instructions. You must cross out item 2 above if you have been notified by the IRS that you are currently subject to backup withholding because you have failed to report all interest and dividends on your tax return. For real estate transactions, item 2 does not apply. For mortgage interest paid, acquisition or abandonment of secured property, cancellation of debt, contributions to an individual retirement arrangement (IRA), and generally, payments other than interest and dividends, you are not required to sign the certification, but you must provide your correct TIN. See the instructions on page 3.

Sign Here **Signature of U.S. person ▶** **Date ▶**

General Instructions

Section references are to the Internal Revenue Code unless otherwise noted.

Future developments. Information about developments affecting Form W-9 (such as legislation enacted after we release it) is at *www.irs.gov/fw9*.

Purpose of Form

An individual or entity (Form W-9 requester) who is required to file an information return with the IRS must obtain your correct taxpayer identification number (TIN) which may be your social security number (SSN), individual taxpayer identification number (ITIN), adoption taxpayer identification number (ATIN), or employer identification number (EIN), to report on an information return the amount paid to you, or other amount reportable on an information return. Examples of information returns include, but are not limited to, the following:

- Form 1099-INT (interest earned or paid)
- Form 1099-DIV (dividends, including those from stocks or mutual funds)
- Form 1099-MISC (various types of income, prizes, awards, or gross proceeds)
- Form 1099-B (stock or mutual fund sales and certain other transactions by brokers)
- Form 1099-S (proceeds from real estate transactions)
- Form 1099-K (merchant card and third party network transactions)
- Form 1098 (home mortgage interest), 1098-E (student loan interest), 1098-T (tuition)
- Form 1099-C (canceled debt)
- Form 1099-A (acquisition or abandonment of secured property)

Use Form W-9 only if you are a U.S. person (including a resident alien), to provide your correct TIN.

If you do not return Form W-9 to the requester with a TIN, you might be subject to backup withholding. See *What is backup withholding?* on page 2.

By signing the filled-out form, you:

1. Certify that the TIN you are giving is correct (or you are waiting for a number to be issued),

2. Certify that you are not subject to backup withholding, or

3. Claim exemption from backup withholding if you are a U.S. exempt payee. If applicable, you are also certifying that as a U.S. person, your allocable share of any partnership income from a U.S. trade or business is not subject to the withholding tax on foreign partners' share of effectively connected income, and

4. Certify that FATCA code(s) entered on this form (if any) indicating that you are exempt from the FATCA reporting, is correct. See *What is FATCA reporting?* on page 2 for further information.

TAXABLE YEAR

CALIFORNIA FORM

2016 Withholding Exemption Certificate 590

The payee completes this form and submits it to the withholding agent. The withholding agent keeps this form with their records.

Withholding Agent

Name

Payee

Name

☐ SSN or ITIN ☐ FEIN ☐ CA Corp no. ☐ CA SOS file no.

Address (apt./ste., room, PO box, or PMB no.)

City (If you have a foreign address, see instructions.)

State

ZIP code

Exemption Reason

Check only one reason box below that applies to the payee.

By checking the appropriate box below, the payee certifies the reason for the exemption from the California income tax withholding requirements on payment(s) made to the entity or individual.

☐ **Individuals — Certification of Residency:**
I am a resident of California and I reside at the address shown above. If I become a nonresident at any time, I will promptly notify the withholding agent. See instructions for General Information D, Definitions.

☐ **Corporations:**
The corporation has a permanent place of business in California at the address shown above or is qualified through the California Secretary of State (SOS) to do business in California. The corporation will file a California tax return. If this corporation ceases to have a permanent place of business in California or ceases to do any of the above, I will promptly notify the withholding agent. See instructions for General Information D, Definitions.

☐ **Partnerships or Limited Liability Companies (LLCs):**
The partnership or LLC has a permanent place of business in California at the address shown above or is registered with the California SOS, and is subject to the laws of California. The partnership or LLC will file a California tax return. If the partnership or LLC ceases to do any of the above, I will promptly inform the withholding agent. For withholding purposes, a limited liability partnership (LLP) is treated like any other partnership.

☐ **Tax-Exempt Entities:**
The entity is exempt from tax under California Revenue and Taxation Code (R&TC) Section 23701 _____ (insert letter) or Internal Revenue Code Section 501(c) _____ (insert number). If this entity ceases to be exempt from tax, I will promptly notify the withholding agent. Individuals cannot be tax-exempt entities.

☐ **Insurance Companies, Individual Retirement Arrangements (IRAs), or Qualified Pension/Profit-Sharing Plans:**
The entity is an insurance company, IRA, or a federally qualified pension or profit-sharing plan.

☐ **California Trusts:**
At least one trustee and one noncontingent beneficiary of the above-named trust is a California resident. The trust will file a California fiduciary tax return. If the trustee or noncontingent beneficiary becomes a nonresident at any time, I will promptly notify the withholding agent.

☐ **Estates — Certification of Residency of Deceased Person:**
I am the executor of the above-named person's estate or trust. The decedent was a California resident at the time of death. The estate will file a California fiduciary tax return.

☐ **Nonmilitary Spouse of a Military Servicemember:**
I am a nonmilitary spouse of a military servicemember and I meet the Military Spouse Residency Relief Act (MSRRA) requirements. See instructions for General Information E, MSRRA.

CERTIFICATE OF PAYEE: Payee must complete and sign below.

To learn about your privacy rights, how we may use your information, and the consequences for not providing the requested information, go to **ftb.ca.gov** and search for **privacy notice**. To request this notice by mail, call 800.852.5711.

Under penalties of perjury, I hereby certify that the information provided in this document is, to the best of my knowledge, true and correct. If conditions change, I will promptly notify the withholding agent.

Type or print payee's name and title _____ Telephone (_____)_____

Payee's signature ▶ _____ Date _____

TAXABLE YEAR **2016**

Nonresident Withholding Allocation Worksheet

CALIFORNIA FORM **587**

The payee completes this form and returns it to the withholding agent.

Part I Withholding Agent

Withholding agent's name

Address (apt./ste., room, PO box, or PMB no.)

City (If you have a foreign address, see instructions.) | State | ZIP code

Part II Nonresident Payee

Payee's name | ☐ SSN or ITIN ☐ FEIN ☐ CA Corp no. ☐ CA SOS file no.

Address (apt./ste., room, PO box, or PMB no.)

City (If you have a foreign address, see instructions.) | State | ZIP code

Nonresident payee's entity type: (Check one)

☐ Individual/sole proprietor ☐ Corporation ☐ Partnership ☐ Limited liability company (LLC) ☐ Estate or trust

Part III Payment Type

Nonresident payee: (Check one)

☐ Performs services totally outside California (no withholding required, skip to Certification of Nonresident Payee)

☐ Provides only goods or materials (no withholding required, skip to Certification of Nonresident Payee)

☐ Provides goods and services in California (see Part IV, Income Allocation)

☐ Provides services within and outside California (see Part IV, Income Allocation)

☐ Other (Describe)_____

If the nonresident payee performs all the services within California, withholding is required on the entire payment for services unless the payee is granted a withholding waiver from the Franchise Tax Board (FTB). For more information, get FTB Pub. 1017, Resident and Nonresident Withholding Guidelines.

Part IV Income Allocation

Gross payments expected from the withholding agent during the calendar year for:

	(a) Within California	(b) Outside California	(c) Total payments
1 Goods and services:			
Goods/materials (no withholding required)			
Services (withholding required)			
2 Rents or lease payments			
3 Royalty payments			
4 Prizes and other winnings			
5 Other payments			
6 Total payments subject to withholding. Add column (a), line 1 through line 5			

Nonresident withholding threshold amount: $1,500.00

Backup withholding threshold amount: $0.00

Certification of Nonresident Payee

To learn about your privacy rights, how we may use your information, and the consequences for not providing the requested information, go to **ftb.ca.gov** and search for **privacy notice**. To request this notice by mail, call 800. 852.5711.

Under penalties of perjury, I certify that the information provided on this document is true and correct. If the reported facts change, I will promptly inform the withholding agent.

Sign Here

Print or type payee's name	Telephone ( )
Payee's signature ▶	Date
Print or type representative's name and title	Telephone ( )
Authorized representative's signature ▶	Date

Grant Agreement
No. 4600009678

GRANT AGREEMENT BETWEEN THE STATE OF CALIFORNIA (DEPARTMENT OF WATER RESOURCES) AND REGIONAL WATER AUTHORITY, AGREEMENT NO. 4600009678
INTEGRATED REGIONAL WATER MANAGEMENT (IRWM) IMPLEMENTATION GRANTS
CALIFORNIA PUBLIC RESOURCES CODE §75026 *ET SEQ*.

THIS AGREEMENT is entered into by and between the Department of Water Resources of the State of California, herein referred to as the "State" and the Regional Water Authority, a joint powers authority in the greater Sacramento, Placer, El Dorado, and Yolo Counties within the State of California, duly organized, existing, and acting pursuant to the laws thereof, herein referred to as the "Grantee", which parties do hereby agree as follows:

1. PURPOSE. State shall provide a grant from the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 to Grantee to assist in financing projects associated with the American River Basin Integrated Regional Water Management (IRWM) Plan pursuant to Chapter 8 (commencing with Section 79560) of Division 26.5 of the California Water Code (CWC), hereinafter collectively referred to as "IRWM Program."

2. TERM OF GRANT AGREEMENT. The term of this Grant Agreement begins on the date this Grant Agreement is executed by State, and terminates on June 1, 2016, or when all of the Parties' obligations under this Grant Agreement are fully satisfied, whichever occurs earlier. Execution date is the date the State signs this Grant Agreement indicated on page 8.

3. GRANT AMOUNT. The maximum amount payable by State under this Grant Agreement shall not exceed $16,030,766. Of the total grant amount, not less than $1,901,293 shall be expended to urban and agricultural water conservation projects in the IRWM effort funded by this Grant Agreement.

4. GRANTEE COST SHARE. The reasonable costs for this Agreement are estimated to be $56,161,041. Grantee shall provide a Cost Share in the amount of at least 25% of the total project cost. Grantee's Total Cost Share is estimated to be $40,130,275. The Required Grantee's Cost Share (i.e., 25%) for purposes of this Agreement shall be $14,040,260. The Grantee's Funding may include cost share incurred after September 30, 2008. Additional explanation of Grantee's Cost Share as it relates to method of payment is provided in Section 10(d).

5. GRANTEE'S RESPONSIBILITY. Grantee shall faithfully and expeditiously perform or cause to be performed all project work as described in Exhibit A (Work Plan) and in accordance with Project Exhibit B (Schedule) and Exhibit C (Budget). Grantee shall comply with all of the terms and conditions of this Grant Agreement and applicable California Public Resources Code (PRC) requirements.

6. LOCAL PROJECT SPONSOR'S RESPONSIBILITY. Grantee shall assign Local Project Sponsors to act on behalf of Grantee for the purposes of individual project management, oversight, compliance, and operations and maintenance. Local Project Sponsors shall be assigned in accordance with the participating agencies identified in the American River Basin IRWM Implementation Program grant application. Exhibit F identifies Local Project Sponsors. Local Project Sponsors shall also act on behalf of Grantee in the fulfillment of Grantee responsibilities where specifically specified in this Grant Agreement.

7. BASIC CONDITIONS. State shall have no obligation to disburse money for a project under this Grant Agreement unless and until Grantee has satisfied the following conditions in accordance with the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006.
   a) By signing this Grant Agreement, Grantee demonstrates the designated Local Project Sponsors for each project are aware of and comply with the provisions of the Grant Agreement between State and Grantee.
   b) Grantee demonstrates the availability of sufficient funds to complete the project, as stated in the Grant Award/Commitment Letter, by submitting the most recent 3 years of audited financial statements.
   c) Grantee complies with PRC §75102 to notify the California Native American tribe (which is on the contact list maintained by the Native American Heritage Commission) of Project Construction if that tribe has traditional lands located within the area of the Project.

d) For groundwater management and recharge projects and for projects with potential groundwater impacts, the Grantee must demonstrate compliance with the groundwater compliance options set forth on page 15 of the IRWM Program Guidelines, dated August 2010.
e) For the term of this Grant Agreement, Grantee submits timely Quarterly Progress Reports as required by Paragraph 17, "Submission of Reports."
f) Grantee submits all deliverables as specified in this Paragraph of this Grant Agreement and Work Plan in Exhibit A.
g) For each project, prior to the commencement of construction or implementation activities, Grantee shall submit to the State the following:
   1) Final plans and specifications certified by a California Registered Civil Engineer as to compliance for each approved project as listed in Exhibit A of this Grant Agreement.
   2) Work that is subject to the California Environmental Quality Act (CEQA) and or environmental permitting shall not proceed under this Grant Agreement until the following actions are performed:
      i. Grantee submits all applicable environmental permits as indicated on the Environmental Information Form to the State,
      ii. Documents that satisfy the CEQA process are received by the State,
      iii. State has completed its CEQA compliance review as a Responsible Agency, and
      iv. Grantee receives written concurrence from the State of Lead Agency's CEQA document(s) and State notice of verification of environmental permit submittal.

      State's concurrence of Lead Agency's CEQA documents is fully discretionary and shall constitute a condition precedent to any work (ex. construction or implementation activities) for which it is required. Therefore, the Grantee should get concurrence from DWR on CEQA before beginning any of the work that is subject to CEQA. Once CEQA documentation has been completed, State will consider the environmental documents and decide whether to continue to fund the project or to require changes, alterations or other mitigation. Grantee must also demonstrate that it has complied with all applicable requirements of the National Environmental Policy Act by submitting copies of any environmental documents, including environmental impact statements, Finding of No Significant Impact, mitigation monitoring programs, and environmental permits as may be required prior to beginning construction/implementation.
   3) For each project included in this Grant Agreement a monitoring plan as required by Paragraph 22, "Project Monitoring Plan Requirements."
h) Since the Grantee's IRWM region (region) receives water supplied from the Sacramento-San Joaquin Delta (Delta), then the region's IRWM Plan (existing or any future update) must help reduce dependence on the Delta for water supply.

8. DISBURSEMENT OF GRANT FUNDS. Following the review of each invoice, State will disburse to Grantee the amount approved, subject to the availability of funds through normal State processes. Notwithstanding any other provision of this Grant Agreement, no disbursement shall be required at any time or in any manner which is in violation of, or in conflict with, federal or state laws, rules, or regulations, or which may require any rebates to the federal government, or any loss of tax-free status on state bonds, pursuant to any federal statute or regulation. For each project, funds will be disbursed by State in response to each approved invoice in accordance with the Exhibit C. Any and all money disbursed to Grantee under this Grant Agreement and any and all interest earned by Grantee on such money shall be used solely to pay Eligible Costs.

9. ELIGIBLE PROJECT COST. Grantee shall apply State funds received only to eligible Project Costs in accordance with applicable provisions of the law and Exhibit C. Eligible project costs include the reasonable costs of studies, engineering, design, land and easement acquisition, legal fees, preparation of environmental documentation, environmental mitigations, monitoring, and project construction. Work performed after the date of grant award, August 16, 2011, shall be eligible for reimbursement. Reasonable administrative expenses may be included as Project Costs and will depend on the complexity of the project preparation, planning, coordination, construction, acquisitions, implementation, and maintenance. Reimbursable administrative expenses are the necessary costs incidentally but directly related to the project including the portion of overhead and administrative expenses that are directly related to the projects included in this Agreement in accordance with the standard accounting practices of the Grantee.

Advanced funds will not be provided. Costs that are not reimbursable with grant funds cannot be counted as cost share. Costs that are not eligible for reimbursement include but are not limited to:

a) Costs, other than those noted above, incurred prior to the award date of the Grant.
b) Operation and maintenance costs, including post construction performance and monitoring costs.
c) Purchase of equipment not an integral part of a project.
d) Establishing a reserve fund.
e) Purchase of water supply.
f) Monitoring and assessment costs for efforts required after project construction is complete.
g) Replacement of existing funding sources for ongoing programs.
h) Travel and per diem costs.
i) Support of existing agency requirements and mandates (e.g. punitive regulatory agency requirements).
j) Purchase of land in excess of the minimum required acreage necessary to operate as an integral part of a project, as set forth and detailed by engineering and feasibility studies, or land purchased prior to the effective date of the grant award with the State.
k) Payment of principal or interest of existing indebtedness or any interest payments unless the debt is incurred after execution of this Grant Agreement, the State agrees in writing to the eligibility of the costs for reimbursement before the debt is incurred, and the purposes for which the debt is incurred are otherwise eligible costs. However, this will only be allowed as Grantee cost share (i.e. Funding Match)
l) Overhead not directly related to project costs.

10. METHOD OF PAYMENT. After the disbursement requirements in Paragraph 7 "Basic Conditions" are met, State will disburse the whole or portions of the Grant Amount to Grantee, following receipt from Grantee of an invoice for costs incurred, and timely Quarterly Progress Reports as required by Paragraph 17, "Submission of Reports."

Invoices submitted by Grantee shall include the following information:

a) Costs incurred for work performed in implementing the IRWM Program or program contracts during the period identified in the particular invoice.
b) Costs incurred for any interests in real property (land or easements) that have been necessarily acquired for a project during the period identified in the particular invoice for the construction, operation, or maintenance of a project.
c) Appropriate receipts and reports for all costs incurred.
d) As the Project will include relatively high cost share amounts (estimated at 71.5% of the total project cost), Grantee's cost share has been divided into "Required Cost Share" and "Additional Cost Share" as documented in Exhibit C. Required Cost Share means twenty five percent of the total project cost and reporting is mandatory. Additional Cost Share means any cost share exceeding 25% and reporting is not mandatory. Grantee is required to maintain records of all cost share (Required and Additional), but Grantee is only responsible for providing documentation to the State to substantiate the Required Cost Share amount (i.e. 25%) unless otherwise requested by State. Retention will not be released until the entire project is complete (grant share, required, and total cost share).
e) Invoices shall be submitted on forms provided by State and shall meet the following format requirements:
    1) Invoices must contain the date of the invoice, the time period covered by the invoice, and the total amount due.
    2) Invoices must be itemized based on the categories specified in the Exhibit C. The amount claimed for salaries/wages/consultant fees must include a calculation formula (i.e., hours or days worked times the hourly or daily rate = the total amount claimed).
    3) Sufficient evidence (i.e., receipts, copies of checks, time sheets) must be provided for all costs included in the invoice.
    4) Each invoice shall clearly delineate those costs claimed for reimbursement from the State's grant amount, as depicted in Paragraph 3, "Grant Amount" and those costs that represent Grantee's and Local Project Sponsors' costs, as applicable, in Paragraph 4, "Grantee Cost Share."
    5) Original signature and date (in ink) of Grantee's Project Manager.

Payment will be made no more than monthly, in arrears, upon receipt of an invoice bearing the Grant Agreement number. Submit the original and three (3) copies of the invoice form to the following address:

Department of Water Resources
Teji Sandhu
901 P Street, Sacramento
CA 94236-0001
Phone: (916) 651-9254
Fax: (916)651-9292
E-mail: tksandhu@water.ca.gov

11. WITHHOLDING OF GRANT DISBURSEMENT BY STATE. If State determines that a project is not being implemented in accordance with the provisions of this Grant Agreement, or that Grantee has failed in any other respect to comply with the provisions of this Grant Agreement, and if Grantee does not remedy any such failure to State's satisfaction, State may withhold from Grantee all or any portion of the Grant Amount and take any other action that it deems necessary to protect its interests. State may require the Grantee to immediately repay all or any portion of the disbursed grant amount with interest, consistent with its determination. State may consider Grantee's refusal to repay the requested disbursed grant amount a contract breach subject to the default provisions in Paragraph 13, "Default Provisions."

    If State notifies Grantee of its decision to withhold the entire grant amount from Grantee pursuant to this Paragraph, this Grant Agreement shall terminate upon receipt of such notice by Grantee and shall no longer be binding on either party.

12. CONTINUING ELIGIBILITY. Grantee must meet the following ongoing requirements to remain eligible to receive State grant funds:
    a) Timely adoption of an IRWM Plan that meets the requirements contained in Part 2.2 of Division 6 of the CWC, commencing with Section 10530.
    b) An urban water supplier that receives grant funds governed by this Grant Agreement shall maintain compliance with the Urban Water Management Planning Act (CWC§10610 *et. seq.*)
    c) For groundwater management and recharge projects and for projects with potential groundwater impacts, the Grantee must demonstrate compliance with the groundwater compliance options set forth on page 15 of the IRWM Program Guidelines, dated August 2010.
    d) Reporting of status of IRWM Plan Update as described in Exhibit E under the heading "Quarterly Progress Report."

13. DEFAULT PROVISIONS. Grantee will be in default under this Grant Agreement if any of the following occur:
    a) Breach of this Grant Agreement, or any supplement or amendment to it, or any other agreement between Grantee and State evidencing or securing Grantee's obligations.
    b) Making any false warranty, representation, or statement with respect to this Grant Agreement.
    c) Failure to operate or maintain projects in accordance with this Grant Agreement.
    d) Failure to make any remittance required by this Grant Agreement.
    e) Failure of Grantee or a Local Project Sponsor receiving grant funding through this Grant Agreement to adopt, no later than 2 years after the State executes the Grant Agreement, an IRWM Plan that meets the requirements contained in Part 2.2 of Division 6 of the CWC, commencing with Section 10530.
    f) Failure to undertake all reasonable and feasible efforts to take into account the water-related needs of disadvantaged communities in the area within the boundaries of the IRWM Plan.
    g) Failure to comply with Labor Compliance Program (LCP) requirements.
    h) Failure to meet any of the requirements set forth in Paragraph 12, "Continuing Eligibility."

    Should an event of default occur, State may do any or all of the following:
    i) Declare the Grant be immediately repaid, with interest, which shall be equal to State of California general obligation bond interest rate in effect at the time of the default.
    j) Terminate any obligation to make future payments to Grantee.
    k) Terminate the Grant Agreement.
    l) Take any other action that it deems necessary to protect its interests.

14. PERMITS, LICENSES, APPROVALS, AND LEGAL OBLIGATIONS: Grantee and Local Project Sponsors shall be responsible for ensuring any and all permits, licenses, and approvals required for performing their obligations under this Grant Agreement are obtained, and shall comply with CEQA (PRC Section 21000 *et seq.*) and other applicable federal, State and local laws, rules, and regulations, guidelines, and requirements for each project described in Exhibit A.

15. RELATIONSHIP OF PARTIES. Grantee and Local Project Sponsors are solely responsible for design, construction, and operation and maintenance of Projects within the American River Basin IRWM Implementation Program. Review or approval of plans, specifications, bid documents, or other construction documents by State is solely for the purpose of proper administration of grant funds by State and shall not be deemed to relieve or restrict responsibilities of Grantee and Local Project Sponsors under this Grant Agreement.

16. GRANTEE REPRESENTATIONS. Grantee accepts and agrees to comply with all terms, provisions, conditions, and written commitments of this Grant Agreement, including all incorporated documents, and to fulfill all assurances, declarations, representations, and statements made by Grantee in the application, documents, amendments, and communications filed in support of its request for Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 financing. Grantee warrants that all Local Project Sponsors will be contractually required to comply with this Grant Agreement for their respective project or projects.

17. SUBMISSION OF REPORTS. The submittal and approval of all reports is a requirement for the successful completion of this Grant Agreement. Reports shall meet generally accepted professional standards for technical reporting and shall be proofread for content, numerical accuracy, spelling, and grammar prior to submittal to State. All reports shall be submitted to the State's Project Manager, and shall be submitted in both electronic and hard copy forms. If requested, Grantee shall promptly provide any additional information deemed necessary by State for the approval of reports. Reports shall be presented in the formats described in the applicable portion of Exhibit E. The timely submittal of reports is a requirement for initial and continued disbursement of State funds. Submittal and subsequent approval by the State, of a Project Completion Report for each project listed on Exhibit A is a requirement for the release of any funds retained for such project.

    - Quarterly Progress Reports: Grantee shall submit Quarterly Progress Reports on a regular and consistent basis to meet the State's requirement for disbursement of funds. Quarterly Progress Reports shall be sent via e-mail, to the State's Project Manager as specified in Exhibit B. Quarterly Progress Reports shall provide a brief description of the work performed, Grantees activities, milestones achieved, updated individual project schedules that provide detail as to how each project is progressing, and any accomplishments and any problems encountered in the performance of the work under this Grant Agreement during the reporting period. The first Quarterly Progress Report should be submitted to DWR no later than August 1, 2012 with future reports then due on successive three month increments based on the invocing schedule and this date.
    - Project Completion Reports: Grantee shall prepare and submit to State a separate Project Completion Report for each project included in Exhibit A. Grantee shall submit a Project Completion Report within ninety (90) calendar days of project completion. Each Project Completion Report shall include a description of actual work done, any changes or amendments to each project, and a final schedule showing actual progress versus planned progress, and copies of any final documents or reports generated or utilized during a project. The Project Completion Report shall also include, if applicable, certification of final project by a registered civil engineer, consistent Standard Condition D-15,"Final Inspections and Certification of Registered Civil Engineer." A DWR "Certification of Project Completion" form will be provided by the State.
    - Grant Completion Report: Upon completion of all projects included in Exhibit A, Grantee shall submit to State a Grant Completion Report. The Grant Completion Report shall be submitted within ninety (90) calendar days of submitting the Project Completion Report for the final project to be completed under the Grant Agreement. The Grant Completion Report shall include reimbursement status, a brief description of each project completed, and how those projects will further the goals of the IRWM Plan and identify any changes to the IRWM Plan, as a result of project implementation. Retention for the last

project to be completed as part of this Grant Agreement will not be disbursed until the Grant Completion Report is submitted to and approved by the State.

- Post-Performance Reports: Grantee shall submit a Post-Performance Report for each project. Post-Performance Reports shall be submitted to State within ninety (90) calendar days after the first operational year of a project has elapsed. This record keeping and reporting process shall be repeated, for each project, annually for a total of 10 years after the completed project begins operation.

18. IRWM PROGRAM PERFORMANCE AND ASSURANCES. Grantee agrees to faithfully and expeditiously perform or cause to be performed all IRWM Program work as described in the final plans and specifications for each project under this Grant Agreement and implement the project in accordance with applicable provisions of the law. In the event State finds it necessary to enforce this provision of this Grant Agreement in the manner provided by law, Grantee agrees to pay all costs incurred by State including, but not limited to, reasonable attorneys' fees, legal expenses, and costs.

19. LABOR COMPLIANCE. Grantee will be required to keep informed of and take all measures necessary to ensure compliance with applicable California Labor Code requirements, including, but not limited to, Section 1720 et seq. of the California Labor Code regarding public works, limitations on use of volunteer labor (California Labor Code Section 1720.4), labor compliance programs (California Labor Code Section 1771.5) and payment of prevailing wages for work done and funded pursuant to these *Guidelines*, including any payments to the Department of Industrial Relations under California Labor Code Section 1771.3.

20. OPERATION AND MAINTENANCE OF PROJECT. For the useful life of construction and implementation projects and in consideration of the Grant made by State, Grantee agrees to ensure or cause to be performed the commencement and continued operation of the projects, and shall ensure or cause the projects to be operated in an efficient and economical manner; shall ensure all repairs, renewals, and replacements necessary to the efficient operation of the same are provided; and shall ensure or cause the same to be maintained in as good and efficient condition as upon its construction, ordinary and reasonable wear and depreciation excepted. The Grantee shall ensure that all operations and maintenance costs of the facilities and structures are contractually assumed by the appropriate Local Project Sponsors for their respective projects; State shall not be liable for any cost of such maintenance, management, or operation. Grantee or Local Project Sponsors may be excused from operations and maintenance only upon the written approval of the State's Project Manager. For purposes of this Grant Agreement, "useful life" means period during which an asset, property, or activity is expected to be usable for the purpose it was acquired or implemented; "operation costs" include direct costs incurred for material and labor needed for operations, utilities, insurance, and similar expenses, and "maintenance costs" include ordinary repairs and replacements of a recurring nature necessary for capital assets and basic structures and the expenditure of funds necessary to replace or reconstruct capital assets or basic structures. Refusal of Grantee to ensure operation and maintenance of the projects in accordance with this provision may, at the option of State, be considered a breach of this Grant Agreement and may be treated as default under Paragraph 13, "Default Provisions."

21. STATEWIDE MONITORING REQUIREMENTS. Grantee shall ensure that all groundwater projects and projects that include groundwater monitoring requirements are consistent with the Groundwater Quality Monitoring Act of 2001 (Part 2.76 (commencing with Section 10780) of Division 6 of CWC) and, where applicable, that projects that affect water quality shall include a monitoring component that allows the integration of data into statewide monitoring efforts, including where applicable, the Surface Water Ambient Monitoring Program carried out by the State Water Resources Control Board.

22. PROJECT MONITORING PLAN REQUIREMENTS. The Grant Agreement work plan should contain activities to develop and submit to State a monitoring plan for each project contained in this Grant Agreement. Monitoring plan can be for the entire Proposal or on a per project basis. Along with the Attachment 6 Project Performance Measures Tables requirements outlined on page 21 of the Proposition 84 Round 1 Implementation Proposal Solicitation Package, the Project Monitoring Plan should also include:
    a) Baseline conditions.

b) Brief discussion of monitoring systems to be utilized.
c) Methodology of monitoring.
d) Frequency of monitoring.
e) Location of monitoring points.

A monitoring plan shall be submitted to the State prior to disbursement of grant funds for construction or monitoring activities for each project in this Grant Agreement. See Exhibit G ("Requirements for Data Submittal") for web links and information regarding other State monitoring and data reporting requirements.

23. NOTIFICATION OF STATE. For each project, Grantee shall promptly notify State , in writing, of the following items:
    a) Events or proposed changes that could affect the scope, budget, or work performed under this Grant Agreement. Grantee agrees that no substantial change in the scope of a project will be undertaken until written notice of the proposed change has been provided to State and State has given written approval for such change. Substantial changes generally include changes to the wording/scope of work, schedule or term, and budget. See Exhibit H for guidance on Agreement Amendment requirements.
    b) Any public or media event publicizing the accomplishments and/or results of this Grant Agreement and provide the opportunity for attendance and participation by State's representatives. Grantee shall make such notification at least fourteen (14) calendar days prior to the event.
    c) Completion of work on a project shall include final inspection of a project by a Registered Civil Engineer, as determined and required by State, and in accordance with Standard Condition D-15 (Final Inspections and Certification of Registered Civil Engineer). Furthermore, the Grantee shall provide the State the opportunity to participate in the inspection. Grantee shall make such notification at least fourteen (14) calendar days prior to the final inspection.

24. NOTICES. Any notice, demand, request, consent, or approval that either party desires or is required to give to the other party under this Grant Agreement shall be in writing. Notices may be transmitted by any of the following means: (i) by delivery in person; (ii) by certified U.S. mail, return receipt requested, postage prepaid; (iii) by "overnight" delivery service; provided that next-business-day delivery is requested by the sender; or (iv) by electronic means. Notices delivered in person will be deemed effective immediately on receipt (or refusal of delivery or receipt). Notices sent by certified mail will be deemed effective given ten (10) calendar days after the date deposited with the U. S. Postal Service. Notices sent by overnight delivery service will be deemed effective one business day after the date deposited with the delivery service. Notices sent electronically will be effective on the date of transmission, which is documented in writing. Notices shall be sent to the below addresses. Either party may, by written notice to the other, designate a different address that shall be substituted for the one below.

25. PERFORMANCE EVALUATION. Upon completion of this Grant Agreement, Grantee's performance will be evaluated by the State and a copy of the evaluation will be placed in the State file and a copy sent to the Grantee.

26. PROJECT REPRESENTATIVES. The Grantee has acknowledged authorization to enter into a cost sharing partnership agreement as documented in Exhibit I. The Project Representatives during the term of this Grant Agreement is as follows.

Department of Water Resources	Regional Water Authority
Paula Landis	John K. Woodling
Chief, Division of IRWM	Executive Director
P.O. Box 942836	5620 Birdcage Street, Suite 180
Sacramento CA 94236-0001	Citrus Heights, CA. 95610
Phone: (916) 651-9220	Phone: (916)967-7692
e-mail: plandis@water.ca.gov	e-mail: jwoodling@rwah2o.org

Direct all inquiries to the Project Manager:

Department of Water Resources Teji Sandhu Division of Integrated Regional Water Management 901 P Street Sacramento, CA. 94236-0001	Regional Water Authority Robert J. Swartz 5620 Birdcage Street, Suite 180 Citrus Heights, CA. 95610
Phone: (916) 651-9254 e-mail: tksandhu@water.ca.gov	Phone: (916) 967-7692 e-mail: rswartz@rwah2o.org

Either party may change its Project Representative or Project Manager upon written notice to the other party.

27. STANDARD PROVISIONS. The following Exhibits are attached and made a part of this Grant Agreement by this reference:

    Exhibit A – Work Plan
    Exhibit B – Schedule
    Exhibit C – Budget
    Exhibit D – Standard Conditions
    Exhibit E – Report Formats and Requirements
    Exhibit F – Local Project Sponsors
    Exhibit G – Requirements for Data Submittal
    Exhibit H – Guidelines for Grantees
    Exhibit I – Grantee Resolution

IN WITNESS WHEREOF, the parties hereto have executed this Grant Agreement.

STATE OF CALIFORNIA DEPARTMENT OF WATER RESOURCES	REGIONAL WATER AUTHORITY
_____ Paula J. Landis, P.E., Chief Division of Integrated Regional Water Management Date_____	_____ John K. Woodling Executive Director Date_____

Approved as to Legal Form and Sufficiency

_____
Spencer Kenner, Assistant Chief Counsel
Office of Chief Counsel

Date_____

EXHIBIT A WORK PLAN

PROJECT 1: CITY OF ROSEVILLE ASR PROGRAM – PHASE 2

Project Description

The project will install the above-ground well equipment for Hayden Park and Del Web wells as part of the City of Roseville's (City) Aquifer Storage and Recovery (ASR) project. Each well will have an injection capacity of 900 gallons per minute (gpm) and extraction capacity of 1,800 gpm. The project will store and recover an estimated average annual 480 acre-feet (AF) per year in the basin.

The total estimated budget for this project is $4,437,513 (Required Cost Share: $750,000; Grant Share: $1,976,397; Additional Cost Share: $1,711,116).

Direct Project Administration

This task includes general project administration, labor compliance, quarterly reporting, and project completion reporting. Project administration includes City council communications, budget adjustments, project status meetings, and communication with RWA and contractors. Labor compliance will be implemented under an approved labor compliance program (LCP). Quarterly reports will be prepared assessing the progress and accomplishments of the project. A project completion report will also be prepared at the end of the project, as well as, annual reports.

The total estimated budget for this task is $79,893 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $79,893).

Land Purchase/Easement

Land and rights-of-way acquisition are not required for the project.

Planning/Design/Engineering/Environmental Documentation

This task includes final design, environmental documentation, and permit preparation activities. The plans and specifications prepared for these wells will be revised and updated, which includes the installation of wellhead facilities on the two installed wells in addition to above-ground improvements. Design will be completed by City staff. From the final plans and specifications, a bid package will be developed for the above-ground infrastructure. For this project, the City of Roseville's Design and Construction Standards will be used as well as any other applicable standards (e.g. California Water Well Standards).

In order to be compliant with the California Environmental Quality Act (CEQA), a project-specific Environmental Impact Report (EIR) will be completed for the City's ASR Program. The budget associated with the drafting and adoption of the EIR is not included here as the project is not requesting grant funds nor will funding match be used for this task.

The City will acquire a Waste Discharge Requirement (WDR) permit from the Regional Water Quality Control Board (RWQCB) for injecting treated water into the aquifer. As the wells are constructed and brought online, the California Department of Public Health (CDPH) needs to approve the use of the wells for public water supply. Therefore, after the construction of the above-ground infrastructure at the two well sites, the City will file Public Water Supply Amendment.

The Bid Package to be used for bid solicitation will be prepared under this task, and will include the final plans and specifications for the Hayden Parkway Well and Del Web Well Above-Ground Infrastructure. Construction submittal will include Insurance Requirements, the Notice to Proceed (NTP), and a Stormwater Pollution Prevention Plan (SWPPP).

The total estimated budget for this task is $391,862 (Required Cost Share: $150,000, Grant Share: $0; Additional Cost Share: $241,862). Direct expenses for permits are included under the "Other" category below.

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Includes clearing grubbing, storm drain inlet protection, stormwater best management practices (BMPs) installation, and electrical, communication and water connection. Potholing will also be conducted at the sites prior to construction to locate and identify any underground structures.

Project Construction

For above-ground well infrastructure includes the installation of well pumps, Baski valves, chemical metering pumps, a 2-inch diameter sewer pipe, a 12-inch diameter water pipe, a 16-inch (or greater) diameter stormwater pipe, and two 500-gallon hypochlorite tanks. Earthwork will include utility and electrical piping, finish grading, and foundation work. Mechanical and electrical work consists of installation of potable water pipe, building a sanitary drain, storm water connection, chemical piping and pumps, well pump, valves, HVAC (if needed), building lighting, electrical/PLC panels, electrical grounding, and instrumentation.

Performance Testing and Demobilization

Performance testing including well start-up and operation with be performed after completion of construction. Operations and maintenance (O&M) manuals will be developed for reference and distribution to operators and City of Roseville staff.

The total estimated budget for Construction/Implementation is $3,089,500 (Required Cost Share: $600,000, Grant Share: $1,976,397; Additional Cost Share: $513,103).

Environmental Compliance/Mitigation/Enhancement

The stormwater BMPs identified in the SWPPP will be implemented, as well as any mitigation measures recommended in the City of Roseville ASR Final EIR (to be completed). Implementation of the approved Project Monitoring Plan (PMP) will be conducted as part of this task.

The total estimated budget for this task is $74,640 (Required Cost Share: $0, Grant Share: $0; Additional Cost Share: $74,640).

Construction Administration

City of Roseville staff will perform construction management services during construction and inspections during construction. Some of these specific work items include review of contractor's schedule and make recommendations; manage and coordinate all contractor correspondence; maintain detailed project records; and perform field construction inspections.

The total estimated budget for this task is $642,500 (Required Cost Share: $0, Grant Share: $0; Additional Cost Share: $642,500).

Other

A Project Monitoring Plan will be prepared as permits described above are obtained.

The total estimated budget for this task is $4,643 ($525 PMP; $4,118 permits (Required Cost Share: $0, Grant Share: $0; Additional Cost Share: $4,643)).

Construction/Implementation Contingency

Contingency is estimated at 5% of the construction/implementation budget. The limited contingency reflects that the below-ground portion of the project has already been completed and past experience with this type of project.

The total estimated budget for this task is $154,475 (Required Cost Share: $0, Grant Share: $0; Additional Cost Share: $154,475).

PROJECT 2: SECRET RAVINE FISH PASSAGE IMPROVEMENT PROJECT

Project Description

This project restores natural channel and floodplain function and increases channel capacity by removing a bridge and pipelines, recontouring stream banks, and adding logs and boulder structures that mimic nature. The barrier removal will provide access to approximately 10 miles of potential spawning and rearing habitat upstream of the project site.

The total estimated budget for this project is $366,551 (Required Cost Share: $0; Grant Share: $311,051; Additional Cost Share: $55,500).

Direct Project Administration

The project has two implementing agencies: the City of Roseville (City) and the Dry Creek Conservancy. The City will be the responsible agency for purposes of compliance with grant funding terms. The City and the Dry Creek Conservancy will enter into a Memorandum of Understanding (MOU) delineating the number of hours and costs associated with the Dry Creek Conservancy time spent on this project, billing procedures and the payment mechanism. Labor compliance will be implemented under an approved LCP. Quarterly reports will be prepared assessing the progress and accomplishments of the Secret Ravine Fish Passage Improvement Project. A project completion report will also be prepared at the end of the project, and annual reports will be prepared.

The total estimated budget for this task is $15,204 (Required Cost Share: $0; Grant Share: $12,204; Additional Cost Share: $3,000).

Land Purchase/Easement

Land for this project is already owned by the City of Roseville. It was deeded to the City through Development Agreements Fee Title. The project area is part of the City's open space.

Planning/Design/Engineering/Environmental Documentation

Planning documents have been prepared to demonstrate the viability of the project and 90% design of the project has been completed. The project design meets the guidelines and standards included in the *California Salmonid Stream Habitat Restoration Manual Part XII* (Michael Love & Kozmo Bates, April 2009). The project is exempt from CEQA review under the provisions of Class 33 Categorical Exemptions as described in Section 15333 of the CEQA guidelines, which states: "Class 33 consists of projects not to exceed five acres in size to assure the maintenance, restoration, enhancement, or protection of habitat for fish, plants or wildlife provided that there are no significant adverse impacts on endangered, rare or threatened species or their habitat pursuant to section 15065…." The following additional permits will be obtained prior to implementation of the project, as follows: City of Roseville Grading Permit and City of Roseville Flood Encroachment Permit. A project bid package will be prepared and a contractor will be secured through a competitive selection process.

The total estimated budget for this task is $68,072 (Required Cost Share: $0; Grant Share: $40,572; Additional Cost Share: $27,500).

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Mobilization and site preparation includes clearing a path to the work area, creating a temporary staging area, and mobilizing large construction equipment, including an excavator, two dump trucks, and a backhoe, to the site. The City of Roseville will demolish existing structures, including bridges abutments, concrete aprons and abandoned utility pipes, and excavation of concrete aprons according to the final design. Demolition debris will be disposed of per local, state and federal requirements.

Project Construction

The contractor will be responsible for installing the stormwater BMPs, the dewatering system, and perform fish relocation. Following demolition, the contractor will restore the stream bed and banks. The contractor will re-grade the channel bed and banks, place large woody debris and rocks in the channel, and install erosion protection. Final steps will include removing the dewatering system and fish blocknets and re-vegetating stream banks, followed by public pathway improvements and interpretive signage.

Performance Testing and Demobilization

Under this work item, the contractor will perform site clean-up and stabilization. This includes final inspection and project certification, and contractor demobilization. A letter of approval, signed by the Design consultant and the biologist, stating that the work was performed to their satisfaction will also be prepared.

The total estimated budget for the Construction/Implementation task is $209,900 (Required Cost Share: $0; Grant Share: $184,900; Additional Cost Share: $25,000).

Environmental Compliance/Mitigation/Enhancement

The City applied for and was granted a Notice of Exemption (NOE) under CEQA Code 15333-Small Restoration Projects. The primary environmental mitigation action required is restoration of the stream bed and re-vegetation of the stream banks.
As part of this task, stormwater BMPs will be implemented and managed. In addition, monitoring required as part of implementation of the Project Monitoring Plan will also be implemented under this task.

The total estimated budget for this task is $36,223 (Required Cost Share: $0; Grant Share: $36,223; Additional Cost Share: $0).

Construction Administration

Construction administration and management will be divided into two components; first, oversight of the demolition of the existing structures will be conducted by the City of Roseville staff; and second, oversight of restoration of the stream bed and banks will be performed by a contractor. Field inspection will be required to inspect structure stability, channel morphology and in-stream habitat.

The total estimated budget for this task is $35,527 (Required Cost Share: $0; Grant Share: $35,527; Additional Cost Share: $0).

Other

This budget item includes liability insurance costs for Dry Creek Conservancy required for this project. A Project Monitoring Plan will be prepared under this task.

The total estimated budget for this task is $1,625 ($525 PMP; $1,100 liability coverage (Required Cost Share: $0; Grant Share: $1,625; Additional Cost Share: $0)).

Construction/Implementation Contingency

No construction/implementation contingency is assumed for this project.

PROJECT 3: E.A. FAIRBAIRN GROUNDWATER WELL PROJECT

Project Description

This project will construct a groundwater well with an estimated capacity of 1,400 gallons per minute at the Fairbairn Water Treatment Plant and implement conjunctive use operations. The well will provide up to 2,250 AF per year in dry years.

The total estimated budget for this project is $1,578,454 (Required Cost Share: $100,000; Grant Share: $988,198; Additional Cost Share: $490,256).

Direct Project Administration

Administration includes council communications, budget adjustments, project status meetings, and communication with RWA and contractors. Labor compliance will be implemented under an approved LCP. A project completion report will also be prepared at the end of the project, as well as, annual reports.

The total estimated budget for this task is $9,760 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $9,760).

Planning/Design/Engineering/Environmental Documentation

Design has not yet started on the proposed project. American Water Works Association (AWWA) standards (including AWWA A-100-06, AWWA Manual No. M21) and California Water Well Standards will be followed along with any other applicable project design and material standards. City staff will prepare a MND for the project in order to comply with CEQA. As part of the MND, a list of mitigation measures to be implemented during construction will be identified and a monitoring plan will be developed. The City will acquire a National Pollutant Discharge Elimination System (NPDES) General Stormwater Permit and a Sacramento County Well Construction Permit. Construction contracting will be completed by the City and consists of the following: Bid advertisement; Pre-bid contractors meeting; Bid opening; Bid evaluation; Award of Contract; NTP.

The total estimated budget for this task is $276,000 (Required Cost Share: $100,000; Grant Share: $0; Additional Cost Share: $176,000). Direct expenses for permits are included under the “Other” category below.

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Includes an onsite meeting with the construction contractor, and equipment mobilization to the project location. The Stormwater BMPs identified in the SWPPP will also be implemented during this stage of construction.

Project Construction

The groundwater well will be drilled to a depth of approximately 350 feet below the ground surface (bgs). Up to a 28-inch diameter borehole will be drilled. The well will be constructed in the borehole following completion with screened intervals to be determined based on field data. During construction, the casing and screen will be centered in the borehole while an engineered filter pack is placed between the screen and the borehole wall. A cement sanitary seal will be placed above the filter pack as part of the well construction. Following well completion, the pump, motor and above-ground facilities will be installed. The contractor will install piping to the potable water system, sewer system, and stormwater system, as well as construct ancillary facilities, including a control building.

Performance Testing and Demobilization

This will include start-up and operation testing of the well and demobilization from the site by the contractor.

The total estimated budget for this task is $1,000,000 (Required Cost Share: $0; Grant Share: $988,198; Additional Cost Share: $11,802).

Environmental Compliance/Mitigation/Enhancement

The contractor will implement the Stormwater BMPs throughout project construction, as well as any other mitigation measure identified in the MND. Implementation of the approved Project Monitoring Plan will be conducted under this task.

The total estimated budget for this task is $10,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $10,000).

Construction Administration

The City of Sacramento Department of Utilities Construction Management Section will provide project inspection during construction and perform all other construction management support. Construction Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $81,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $81,000).

Other

A Project Monitoring Plan will be prepared and permits described above will be obtained.

The total estimated budget for this task is $1,694 ($525 PMP; $1,169 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $1,694)).

Construction/Implementation Contingency

A construction/implementation contingency of 20% of construction costs has been included because the project is in a fairly preliminary stage and unknown conditions may arise.

The total estimated budget for this task is $200,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $200,000).

PROJECT 4: SHASTA PARK RESERVOIR AND WELL PROJECT

Project Description

This project includes constructing a groundwater well with an estimated capacity of 1,500 gallons per minute, a four million gallon reservoir, and booster pump station, which will increase the City of Sacramento's (City) conjunctive use capacity in south Sacramento. The well will provide up to 2,250 AF per year in dry years. The facility will also address chronic low pressure and fire flow concerns to a disadvantaged part of the City.

The total estimated budget for this project is $14,082,458 (Required Cost Share: $5,400,000; Grant Share: $988,199; Additional Cost Share: $7,694,259).

Direct Project Administration

Administration includes council communications, budget adjustments, project status meetings, and communication with RWA and contractors. The City has a Department of Industrial Relations (DIR) certified LCP in place. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the Shasta Park Reservoir and Well Project. A completion report will be prepared at the end of the project, as well, as, annual reporting

The total estimated budget for this task is $20,320 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $20,320).

Land Purchase/Easement

The City's has completed the purchase of 5.31 acres of real estate to support this project from the Sacramento Housing and Redevelopment Agency.

The total cost for this task was $580,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $580,000).

Planning/Design/Engineering/Environmental Documentation

The criteria for evaluating the site included hydraulics, constructability, land acquisition cost, regulatory approval, facility cost, extent of disruption to existing customers, and compatibility for the proposed uses. No other planning documents are required prior to design of this project.
For this project, AWWA standards (including AWWA A-100-06, AWWA Manual No. M21) and California Water Well Standards will be followed along with any other applicable project design and material standards. City staff have prepared a MND for the project to comply with CEQA. As part of the MND, a list of mitigation measures to be implemented during construction have been identified and a monitoring plan has been be developed as part of the Mitigation, Monitoring and Reporting Program. The following permits will be needed for this project and will be obtained prior to the start of construction: NPDES General Stormwater Permit for Construction; Sacramento County Well Construction Permit; Sacramento County Encroachment Permit. The CDPH will need to approve the use of the wells and reservoir for public water supply; therefore, after construction is complete, the City will file a Public Water Supply Amendment. The certification from CDPH is ministerial and is not included in the budget or schedule in this project. Construction contracting will be completed by the City of Sacramento and consists of the following: Bid advertisement; Pre-bid contractors meeting; Bid opening; Bid evaluation; Award of Contract; NTP.

The total estimated budget for this task is $1,313,523 (Required Cost Share: $400,000; Grant Share: $0; Additional Cost Share: $913,523). Direct expenses for permits described above are included under the "Other" category below.

Construction/Implementation

Construction for the groundwater well and reservoir will be constructed sequentially. Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Includes an onsite meeting with the construction contractor, and equipment mobilization to the project location. The Stormwater BMPs identified in the SWPPP (to be prepared by the contractor) will be installed during this stage of construction.

Project Construction

The four million gallon reservoir is expected to be constructed of concrete, and will include up to 850 lineal feet each of transmission and drainage piping, an exterior security wall of approximately 1,100 lineal feet, electrical, meters, landscaping, control building, and up to four reservoir booster pumps. The groundwater well will be drilled to a depth of approximately 1200 feet below ground surface (bgs). A30-inch diameter borehole will be drilled. The well will be constructed in the borehole following completion with screened intervals to be determined based on field data. Following well completion, the pump, motor and above-ground facilities will be installed. The contractor will install piping to the potable water system, sewer system, and stormwater system, as well as construct ancillary facilities, including meter, treatment systems, chemical systems, electrical, and a control building.

Performance Testing and Demobilization

This will include start-up and operation testing of the well and demobilization from the site by the contractor.

The total estimated budget for this task is $9,835,610 (Required Cost Share: $5,000,000; Grant Share: $988,199; Additional Cost Share: $3,847,411).

Environmental Compliance/Mitigation/Enhancement

The contractor will implement the Stormwater BMPs throughout project construction, as well as any other mitigation measures identified in the MND. The proposed project site is located on land occupied by the Swainson's Hawk (a sensitive species) and other environmental documents suggest that mitigation for the lost habitat may be required on a 1:1 basis. Finally, implementation of the approved Project Monitoring Plan will be conducted as part of this task.

The total estimated budget for this task is $90,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $90,000).

Construction Administration

The City of Sacramento Department of Utilities Construction Management Section will provide project inspection during construction and perform all other construction management support. Construction

Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $470,800 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $470,800).

Other

This task includes preparing the Project Monitoring Plan and direct permit expenses.

The total estimated budget for this task is $2,723 ($525 PMP; $2,198 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $2,723)).

Construction/Implementation Contingency

A construction/implementation contingency of 20% has been included because the project is in a fairly preliminary stage and there may be unknown conditions.
The total estimated budget for this task is $1,769,482 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $1,769,482).

PROJECT 5: ANTELOPE CREEK INTEGRATED FLOOD CONTROL PROJECT

Project Description

This is a multi-objective water efficiency and regional flood control improvement project proposed within the Dry Creek Watershed area of the American River Basin. This project includes the first phase of a two-phase project. The first phase would include the concrete gunite lining and other improvements of the Antelope Creek/Canal and its tributaries and the construction of one (in a future series of two) on-channel flood control weirs on Antelope Creek. The project will conserve up to 125 AF per year, reduce the amount of erosion in the watershed, improve water quality and reduce peak flow from a 100-year storm event by 530 cubic feet second on Antelope Creek near Atlantic Street in the City of Roseville. For grant management purposes, the project has been split into two project elements (Antelope Creek Integrated Flood Control Project and Antelope Creek Integrated Water Efficiency Project). The flood control portion of the project sponsored by Placer County Flood Control and Water Conservation District is described below.

The total estimated budget for this project is $1,519,699 (Required Cost Share: $100,000; Grant Share: $741,149; Additional Cost Share: $678,550).

Direct Project Administration

Administration includes Board communications, budget adjustments, project status meetings, and communication with RWA and contractors and communication between the two participating agencies, Placer County Water Agency (PCWA) and Placer County Flood Control and Water Conservation District (PCFCWCD). Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the project. A completion report will also be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $25,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $25,000).

Land Purchase/Easement

The City of Roseville owns and maintains the current open space zoned property over which the flood control portion of Phase 1 of the project is proposed, so there are no assumed costs for this task.

Planning/Design/Engineering/Environmental Documentation

Planning documents have been prepared to demonstrate the viability of the project. At this time, the project has completed the conceptual (10%) design stage. During design, AWWA and American Society for Testing and Materials (ASTM) Construction Standards and OSHA regulations and industry standard practice will be used as construction standards and health and safety standards. The following permits will be required to implement the project: Department of Fish and Game 1600 Streambed Alteration Agreement allowing for work within the stream channel; U.S. Army Corps of Engineers Section 404 Encroachment Permit; RWQCB Section 401 Permit for water quality certification; Central Valley Flood Protection Board (CVFPB) Encroachment Permit; City of Roseville Grading and Encroachment Permit; City of Roseville Tree Mitigation Permit. In addition to the above mentioned permits, the contractor will file and comply with a SWPPP, which will be submitted to the

City of Roseville and Placer County. A project bid package will be prepared and a contractor will be secured through a competitive selection process.

The total estimated budget for this task is $370,000 (Required Cost Share: $100,000; Grant Share: $50,000; Additional Cost Share: $220,000).

Construction/Implementation

Construction of the Antelope Creek Integrated Flood Control Project will be conducted over two construction seasons due to the increase in flows during the winter months. Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Upon receipt of the NTP, the contractor will begin mobilization and site preparation activities. These activities will include selective clearing and grubbing of debris and invasive species within the floodplain construction areas; instituting tree protection measures; and following all prescribed SWPPP measures.

Project Construction

Following completion of site preparation activities, the contractor will perform project construction activities. This includes general site grading, excavating and hauling for weir construction, floodplain restoration, forming and pouring the concrete flood control weir, installation of the ALERT stream level gauges, re-landscaping, installing a temporary irrigation system, and installing interpretive signs.

Performance Testing and Demobilization

During completion of construction activities, the contractor will perform required materials testing and monitoring. This includes geotechnical testing of flood control weir base materials, earthwork compaction testing, concrete materials testing and plant establishment and monitoring. Following construction site cleanup activities, PCFCWCD will begin the three-year plant establishment monitoring period and begin monitoring the stream level gauges to determine storage and peak flow reduction results. Final inspection and project certification will also be performed, along with contractor demobilization.

The total estimated budget for this task is $711,149 (Required Cost Share: $0; Grant Share: $691,149; Additional Cost Share: $20,000).

Environmental Compliance/Mitigation/Enhancement

A project-specific Project Monitoring Plan will be prepared for this project to direct longer-term project monitoring to ensure successfully project implementation and operation.

The total estimated budget for this task is $177,215 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $177,215).

Construction Administration

Construction Administration includes Construction Management services and other administrative activities relating to project implementation. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $121,138 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $121,138).

Other

This task includes preparing the Project Monitoring Plan and payment for the permits described above.

The total estimated budget for this task is $8,525 ($525 PMP; $8,000 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $8,525)).

Construction/Implementation Contingency

A construction/implementation contingency of 15% will be used for this project, which is based on previous projects and the state of the current project.

The total estimated budget for this task is $106,672 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $106,672).

PROJECT 6: REGIONAL WATER METER RETROFIT ACCELERATION PROJECT

Project Description

The Regional Water Meter Retrofit Acceleration Project will install 840 additional residential meters in the service areas of the City of Sacramento, Sacramento Suburban Water District, and Sacramento County Water Agency. The meters will conserve an estimated 126 AF per year.

The total estimated budget for this project is $959,545 (Required Cost Share: $0; Grant Share: $913,095; Additional Cost Share: $46,450).

Direct Project Administration

Administration includes Board and Council communications with the respective agencies, budget adjustments, project status meetings, and communication with RWA and contractors. This project is being administered by RWA; however, the meters will be installed in the City of Sacramento, Sacramento Suburban Water District, and Sacramento County Water Agency service areas. Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the Regional Water Meter Retrofit Acceleration Project. A project completion report will also be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $17,340 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $17,340).

Land Purchase/Easement

This is not required for this project.

Planning/Design/Engineering/Environmental Documentation

Each agency has an ongoing meter installation program, so minimal preparation of final design and specifications would be needed to commence the project. All installed residential water meters will comply with design and accuracy specifications of the AWWA and shall be NSF-approved lead free. The meters will be connected to residential water services in accordance with the Uniform Plumbing Code (UPC). For the Regional Water Meter Retrofit Acceleration Project, a Categorical Exemption will be filed as the project will not have any significant impacts on the environment. For this project, a Sacramento County Encroachment Permit must be acquired to be allowed to work in County easements. These permits are issued on an annual basis for agency operations and maintenance. For the water meters located in the City of Sacramento, no permits will be required.

The total estimated budget for this task is $6,480 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $6,480).

Construction/Implementation

The Regional Water Meter Retrofit Acceleration Project participants (namely the City of Sacramento, Sacramento Suburban Water District and the Sacramento County Water Agency) select contractors through a competitive process on a fiscal year basis for implementation of similar types of work; therefore, these agencies will modify the existing contracts to incorporate the Regional Water Meter Retrofit Acceleration Project as part of the overall contract scope. Construction is divided into three

categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

The contractors will mobilize their equipment and crew to their respective, designated staging areas. Some of the equipment that will be required for implementation of the Regional Water Meter Retrofit Acceleration Project include: a backhoe, low bed, and crew truck; this equipment will be brought to the site during this subtask.

Project Construction

During project construction, the 840 residential water meters will be installed. The contractors will perform the installations within OSHA and any other applicable codes, regulations, and ordinances during construction.

Performance Testing and Demobilization

Representatives of the participating agencies will perform post-construction inspections to verify proper meter installation. Additionally, as part of this work item, demobilization and site restoration (as required) by the contractor will be completed.

The total estimated budget for this task is $924,000 (Required Cost Share: $0; Grant Share: $913,095; Additional Cost Share: $10,905).

Environmental Compliance/Mitigation/Enhancement

A Categorical Exemption will be filled for this project, so no mitigation measures will be required. Contractors will prepare erosion, sediment and pollution control plans to protect water quality during construction. Implementation of an approved Project Monitoring Plan will occur under this task.

The total estimated budget for this task is $3,600 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $3,600).

Construction Administration

Construction Administration includes Construction Management services. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $7,200 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $7,200).

Other

This task includes preparing the Project Monitoring Plan and securing of permits identified above.

The total estimated budget for this task is $925 ($525 PMP; $400 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $925)).

Construction/Implementation Contingency

A construction/implementation contingency will not be applied to this project as the installation of water meters is not a complex construction activity and the participants have significant prior experience in meter retrofits and will assume any additional costs.

PROJECT 7: REGIONAL INDOOR AND OUTDOOR WATER EFFICIENCY PROJECT

Project Description

The Regional Indoor and Outdoor Water Efficiency Project consists of four components that will conserve an estimated 9,615 AF over the life of the programs. The four programs are: (1) no-cost interior water efficiency fixture retrofits, primarily targeted (goal of 75%) at disadvantaged communities; (2) exterior single family water use surveys and upgrades; (3) exterior water use surveys and upgrades for large landscapes, including commercial, industrial and institutional (CII) and residential agriculture landscapes; and (4) the preparation of water use budgets for accounts with dedicated landscape meters. The estimated average annual conservation from the project is 480 AF per year.

The total estimated budget for this project is $1,004,439 (Required Cost Share: $0; Grant Share: $988,198; Additional Cost Share: $16,241).

Direct Project Administration

Administration includes general communications, budget adjustments, project status meetings, and communication with contractors, local agency staff and internal communication at RWA. If labor compliance is required, it will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the Regional Indoor and Outdoor Water Efficiency Project. A project completion report will also be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $33,499 (Required Cost Share: $0; Grant Share: $17,558; Additional Cost Share: $15,941).

Land Purchase/Easement

This is not required for this project.

Planning/Design/Engineering/Environmental Documentation

The project is designed to reduce water use as a means towards compliance with California law requiring a 20% water reduction in per capita water use Statewide by the year 2020. The majority of the planning documents required for implementation have been prepared by local agency and RWA staff. These documents demonstrate the efficacy of the proposed conservation measures and were developed based on guidance documents prepared by DWR and the California Urban Water Conservation Council (CUWCC). This project will follow all design and material standards documented in the CUWCC MOU as well as any other applicable standards. No permits are required for this project.

The total estimated budget for this task is $3,360 (Required Cost Share: $0; Grant Share: $3,360; Additional Cost Share: $0), which will be fully funded by the grant.

Construction/Implementation

Implementation will consist of the following four primary elements:

- **Interior Conservation Retrofits** - This effort will provide a complete interior water conservation retrofit for up to 1,098 households in the Greater Sacramento Area, with a goal of 75% (or 825) of the retrofits targeted at disadvantaged customers. The retrofit will include a standard survey of interior water use; direct, no-cost installation of indoor water efficiency devices including toilets, showerheads, and faucet aerators and hose-end shut-off valves will be provided for exterior hose bibs.
- **Exterior Residential Water Use Surveys and Upgrades** - For single-family accounts, provide up to 285 exterior water use surveys (landscape audits) and up to $500 for each completed survey in irrigation system upgrades.
- **Exterior Large Landscape Water Use Surveys and Upgrades** - For large landscapes, including CII and residential agriculture accounts with mixed-use meters, provide up to three workshops on water efficiency for large landscape customers throughout the region and up to 76 exterior water surveys, which include up to $1,500 for each completed survey in irrigation system upgrades.
- **Landscape Water Budgets** - Prepare up to 404 landscape water budgets for dedicated landscape irrigation meters in accordance with the state's current Model Water Efficient Landscape Ordinance.

The total estimated budget for this task is $884,500 (Required Cost Share: $0; Grant Share: $884,500; Additional Cost Share: $0).

Environmental Compliance/Mitigation/Enhancement

No environmental compliance, mitigation, or enhancement will be required for this project. This task will include implementation of an approved Project Monitoring Plan.

The total estimated budget for this task is $2,300 (Required Cost Share: $0; Grant Share: $2,300; Additional Cost Share: $0).

Construction/Implementation Administration

Implementation administration includes will include the following items: Review contractor's schedule and make recommendations; manage and coordinate all project inquiries, serve as focal point; manage and coordinate all contractor correspondence; maintain detailed project records; receive, log, and distribute all submittals for review; coordinate inspection of completed items with local agencies; recommend final payment and submit all project files for archiving.

The total estimated budget for this task is $80,480 (Required Cost Share: $0; Grant Share: $80,480; Additional Cost Share: $0).

Other

This task includes preparing the final Project Monitoring Plan.

The total estimated budget for this task is $300 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $300).

Construction/Implementation Contingency

An implementation contingency will not be applied to this project as the installation of water efficiency measures is not a complex construction activity.

PROJECT 8: SACRAMENTO REGIONAL COUNTY SANITATION DISTRICT / SACRAMENTO POWER AUTHORITY RECYCLED WATER PROJECT

Project Description

This Project consists of the construction of recycled water pipeline facilities at the Sacramento Regional County Sanitation District (SRCSD) Sacramento Regional Wastewater Treatment Plant (SRWTP), transmission pipelines outside of the SRWTP, and piping modifications at the SPA Cogeneration Facility to convey recycled water from the SRWTP to replace approximately 1,000 AF per year of potable water currently being used for cooling purposes.

The total estimated budget for this project is $9,165,994 (Required Cost Share: $2,700,000; Grant Share: $1,547,519; Additional Cost Share: $4,918,475).

Direct Project Administration

Administration includes internal communications, budget adjustments, project status meetings, and communication and coordination with RWA and contractors. Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the SRCSD/Sacramento Power Authority (SPA) Recycled Water Project. A project completion report will also be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $133,805 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $133,805).

Land Purchase/Easement

The SRWTP property has been owned by SRCSD since the 1970s and the SPA owns the Cogeneration Plant property, but other land easement acquisitions may be required in order to implement this project. The pipeline alignment between the northern property boundary of the SRWTP and the southern terminus point of 24th Street, referred to as Delta Shores, does not appear to have existing right-of-way and it is anticipated that easements would need to be secured in this area. Also, it may be necessary to acquire easements/right-of-ways and temporary construction easements along sections of the alignment along 24th Street and 47th Avenue in order to facilitate the construction and maintenance of the pipeline and related appurtenances. Since the existing lands within Delta Shores are undisturbed lands, installation of the recycled water transmission main is expected to be faster and cheaper compared to the other sections of pipeline. Based on prior experiences with similar projects, 5% of project construction costs is assumed for the cost of project easements.

The total estimated budget for this task is $310,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $310,000).

Planning/Design/Engineering/Environmental Documentation

SRCSD will solicit for engineering services to complete design for the SRCSD/SPA Recycled Water Project. A Negative Declaration will be drafted for the pipeline proposed in this project. Four permits must be acquired prior to project implementation. The SRCSD Treated Wastewater Change Petition

WW-28, was completed in July 1996, providing approval under Section 1211 and 1700 of the California Water Code to change the place of use and purpose of use of treated wastewater. Potential amendments to California Energy Commission (CEC) License and Title 5 Air Permit, may be required to operate the SPA Cogeneration Plant. Encroachment permits from local jurisdictions/agencies allowing for the construction of utilities in public right-of-ways. A Department of Fish and Game Section 1600 Streambed Alteration Agreement to cross Laguna Creek at the SRWTP property. This permit may not be required should SRCSD construct the crossing under Laguna Creek using tunneling methods to avoid mitigation impacts and accelerate the acquisition of permits. If required, a U.S. Army Corps of Engineers Section 404 Encroachment Permit as well as a RWQCB Section 401 Permit for water quality certification will also be acquired. SRCSD will release a Notice to Contractors for the SRCSD/SPA Recycled Water Project. After review of the bids, SRCSD will select a bid and provide the NTP to the selected contractor. A SWPPP will be developed and provided by the Contractor.

The total estimated budget for this task is $1,295,498 (Required Cost Share: $700,000; Grant Share: $0; Additional Cost Share: $595,498).

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Mobilization and site preparation includes clearing a path to the work area, creating a temporary staging area, mobilizing large construction equipment to the site and storm drain inlet protection. Pre-construction surveys and soil borings along the pipeline will be performed and will identify existing utilities, rights-of-way, environmentally sensitive areas and above ground and underground road conditions. Mitigation measures such as the BMPs identified in the SWPPP will also be set-up under this subtask.

Project Construction

Project construction consists of the installation of the pipeline and all other appurtenances and improvements and modifications to the treatment and piping system at the water recycling facility and to the cogeneration plant piping system. This includes trench construction and stabilization, traffic control, pipe installation, backfill and compaction of the trench. The pipeline will consist of approximately 6.3 miles of 12-inch diameter recycled water pipeline.

Performance Testing and Demobilization

After completion of construction, the pipeline and modifications to the water recycling facility and cogeneration plant will be tested. Once completed, the construction site will be cleaned and fencing installed to protect the pipeline. The pipeline and modifications will then be inspected to ensure compliance with all applicable standards and regulations.

The total estimated budget for this task is $5,575,200 (Required Cost Share: $2,000,000; Grant Share: $1,547,519; Additional Cost Share: $2,027,681)**.**

Environmental Compliance/Mitigation/Enhancement

The SWPPP and permit compliance measures will be implemented. Construction of the pipeline segments along specific areas of the SRWTP property will avoid seasonal nesting areas. Monitoring

required as part of implementation of the Project Monitoring Plan will be implemented and includes implementation of the required performance monitoring, data assessment, and reporting.

The total estimated budget for this task is $66,902 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $66,902). **.**

Construction Administration

Construction Administration includes Construction Management services. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $669,024 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $669,024).

Other

This task includes preparing the final Project Monitoring Plan.

The total estimated budget for this task is $525 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $525).

Construction/Implementation Contingency

A construction/implementation contingency of 20% has been included and is detailed in the associated budget. The contingency percentage is based on SRCSD's prior experience and typical industry standards for this stage of a project.

The total estimated budget for this task is $1,115,040 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $1,115,040).

PROJECT 9: NORTH ANTELOPE BOOSTER PUMP STATION PROJECT

Project Description

This project will construct a booster pump with a capacity of 4,200 gallons per minute to provide for the reversal of flow in the Antelope and Cooperative Transmission pipeline. This will increase the operational flexibility within the system and create additional opportunities for conjunctive use practices in the region.

The total estimated budget for this project is $918,412 (Required Cost Share: $200,000; Grant Share: $261,873; Additional Cost Share: $456,539).

Project Administration

Administration includes Board communications, budget adjustments, project status meetings, and communication with RWA and contractors. Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared, a project completion report will be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $34,844 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $34,844).

Land Purchase/Easement

The land for the proposed project is currently owned by SSWD.

Planning/Design/Engineering/Environmental Documentation

Feasibility of the project will require an inter-agency agreement among the project beneficiaries. The conceptual (10%) design for this project has been completed. The final design report for the booster pump station will be completed along with a bid package for the project. For this project, AWWA standards (including AWWA A-100-06, AWWA Manual No. M21) and SSWD Standard Details and Specifications will be followed along with any other applicable project design and material standards. SSWD anticipates filing a Negative Declaration for CEQA compliance. The following permits will be required for the completion of the project and will be obtained before construction begins: CDPH Permit Amendment; Public Water Supply Amendment; and County of Sacramento Electrical Permit. Following completion of final design, a bid package will be released and the contractor will be selected based on a competitive selection process.

The total estimated budget for this task is $167,742 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $167,742). Direct expenses for permits are included under the “Other” category below.

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Mobilization and site preparation includes an onsite meeting with the construction contractor, and equipment mobilization to the project location. Based on the final pump station layout and

requirements for maintenance access to the existing pressure reducing valve (PRV) station equipment, the existing access gate may need to be relocated. If so, the gate will be moved during this phase of construction. On-site safety equipment will be installed at this stage. The Stormwater BMPs identified in the SWPPP (to be prepared by the contractor) will also be installed during this stage of construction.

Project Construction

Prior to installation of the pump station facilities, the site will be excavated in accordance with the final plans and specifications. Construction of the pump station includes construction and installation of piping and appurtenances, two magnetic flow meters and two 50 horsepower centrifugal pumps. A motor control center with a transformer, controls and instrumentation will also be installed during this phase.

Performance Testing and Demobilization

Following construction of the pump station, start-up and control testing will be performed. Testing will include meter flow testing and calibration, motorized valve control testing and calibration, and pump flow rate testing. Finally, general site cleanup and demobilization will be performed and final project certification will be performed.

The total estimated budget for this task is $527,800 (Required Cost Share: $200,000; Grant Share: $261,873; Additional Cost Share: $65,927).

Environmental Compliance/Mitigation/Enhancement

SSWD has not begun environmental documentation; however, SSWD anticipates filing a Negative Declaration. A SWPPP will be prepared and implemented as part of project construction and only standard stormwater BMPs are expected to be required. Implementation of an approved Project Monitoring Plan will be implemented under this task.

The total estimated budget for this task is $9,600 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $9,600).

Construction Administration

Construction Administration includes Construction Management services. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $65,476 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $65,476).

Other

This task includes preparing the final Project Monitoring Plan and direct permit expenses.
The total estimated budget for this task is $7,390 ($525 PMP; $6,865 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $7,390)).

Construction/Implementation Contingency

A construction/implementation contingency of 20% will be used for the project. This percentage was based on prior experience with similar projects at this stage of design.

The total estimated budget for this task is $105,560 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $105,560).

PROJECT 10: COYLE AVENUE AND ROSEVIEW PARK PUMP STATIONS AND TREATMENT SYSTEMS PROJECT

Project Description

The project will construct two 1,200-square foot pump stations and two new production wells with estimated capacities of 1,800 gpm and 1,400 gpm in Sacramento Suburban Water District's (SSWD) north service area. When operated as part of a conjunctive use program, the wells are expected to yield an average annual supply of 2,000 AF.

The total estimated budget for this project is $5,706,162 (Required Cost Share: $1,800,000; Grant Share: $1,482,298; Additional Cost Share: $2,423,864).

Direct Project Administration

Administration includes council communications, budget adjustments, project status meetings, and communication with RWA and contractors. Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project. A project completion report will be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $59,295 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $59,295).

Land Purchase/Easement

The Coyle well site is currently owned by SSWD. SSWD has submitted an offer letter to the Sunrise Recreation and Park District (SRPD) for the Roseview Park site. SRPD is currently finalizing the offer from SSWD. The purchase price for the Coyle Avenue site was $36,500 and the estimated purchase price for the Roseview Park site is $32,900.

The total estimated budget for this task is $69,400 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $69,400).

Planning/Design/Engineering/Environmental Documentation

The design of the Coyle well has been completed; the pump station and treatment facility design is currently underway. For this project, AWWA standards (including AWWA A-100-06, AWWA Manual No. M21) and California Water Well Standards will be followed along with any other applicable project design and material standards. A Draft IS/ND has been prepared and was published for public comment. Per the Draft IS/ND, the proposed project will not cause any significant adverse environmental impacts. This is not expected to change with completion of the Final IS/ND. The following permits have been obtained for the Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project: County of Sacramento Well Construction Permit; and CDPH Permit Amendment. The following permits for each well will be required for the completion of the project and will be obtained before construction begins: County of Sacramento Sewer Permit; County of Sacramento Water Agency Permit; NPDES Permit Amendment; and Public Water Supply Amendment. Following completion of final design, a bid package will be released and the contractor will be selected based on a competitive selection process.

The total estimated budget for this task is $420,750 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $420,750). Direct expenses for permits are included under the "Other" category below.

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Mobilization and site preparation includes an onsite meeting with the construction contractor, and equipment mobilization to the project location. The Stormwater BMPs identified in the SWPPP (to be prepared by the contractor) will also be installed during this stage of construction.

Project Construction

Construction of the wells includes the drilling operations, casing installation, filter pack placement, sanitary seal placement and wellhead completion. Detailed specifications and plans for the wells, found in the Wells Final Design Package, are included as an attachment to this work plan. Pump station and treatment system construction for the Coyle Avenue Site includes construction of the 1,200 square foot masonry pump station, installation of above-ground appurtenances such as flow meters, valves and instrumentation, and installation of approximately 200 linear feet of either 12-inch or 16-inch underground piping to convey water from the well to the SSWD distribution system. Additionally, 200 linear feet of 15- to 18-inch underground storm drain will be installed, connecting the well pump-to-waste piping to the existing Sacramento County-owned storm drain system. A motor control center with pad-mounted transformer, controls, instrumentation, lighting, heating, fencing, landscaping and irrigation facilities will also be installed during this phase. Pump station and treatment system construction for the Roseview Park Site is identical to that of the Coyle Avenue site with the following exceptions: 600 to 1,200 lineal feet of 18-inch underground storm drain will be required for connecting the well pump-to-waste piping to the Sacramento County-owned storm drain system and 600 lineal feet of 4-inch underground sewer line will be required to connect to the existing Sacramento County-owner sewer system. The wellhead treatment systems at both sites, constructed in the pump stations, will consist of a chlorination treatment for disinfection and possibly a manganese removal system. More details and specifications for the wellhead treatment system will be known once the wells have been constructed and additional water quality data have been gathered.

Performance Testing and Demobilization

Following construction of the wells, test well pumps and discharge piping will be installed in the new wells. The new wells will then be developed and water quality samples will be taken and analyzed. The pump volume and drawdown will be determined at each site and one final report summarizing all of the performance testing that occurred will be drafted. Performance testing for the pump stations and treatment systems will include pressure testing and pump testing with water quality samples collected during start-up to ensure the treatment system is effective. Finally, the CDPH will inspect the sites to ensure they meet all required codes.

The total estimated budget for this task is $4,011,935 (Required Cost Share: $1,800,000; Grant Share: $1,482,298; Additional Cost Share: $729,637).

Environmental Compliance/Mitigation/Enhancement

As previously mentioned, a Negative Declaration has been prepared for this project; therefore, no mitigation measures are anticipated. A SWPPP will be prepared and implemented at both sites as part of project construction; thus only standard Stormwater BMPs will be implemented through the construction period. Finally, implementation of the approved Project Monitoring Plan will also be conducted as part of this task.

The total estimated budget for this task is $38,400 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $38,400).

Construction Administration

Construction Administration includes Construction Management tasks. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $267,440 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $267,440).

Other

This task includes preparing the Project Monitoring Plan and securing of permits described above.

The total estimated budget for this task is $36,555 ($525 PMP; $36,030 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $36,555)).

Construction/Implementation Contingency

A construction/implementation contingency of 20% will be used for the Coyle Avenue and Roseview Park Pump Stations and Treatment Systems Project. This percentage was based on prior experience with similar projects at this stage of design.

The total estimated budget for this task is $802,387 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $802,387).

PROJECT 11: WILLOW HILL PIPELINE REHABILITATION PROJECT

Project Description

This project will repair one of the highest water loss areas identified in the City of Folsom through a leak detection and repair program. Improvements will include lining and other repairs of the Willow Hill pipeline and lining of the Willow Hill Reservoir. This part of Folsom's system currently loses up to 1 million gallons per day or about 1,100 AF per year.

The total estimated budget for this project is $7,606,671 (Required Cost Share: $2,600,000; Grant Share: $1,926,987; Additional Cost Share: $3,079,684).

Direct Project Administration

Administration includes council communications, budget adjustments, project status meetings, and communication with RWA and contractors. Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the Willow Hill Pipeline Rehabilitation Project. A project completion report will also be prepared at the end of construction, as well as, annual reporting.

The total estimated budget for this task is $94,507 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $94,507).

Land Purchase/Easement

The City of Folsom owns both the infrastructure and the associated property within the project boundary.

Planning/Design/Engineering/Environmental Documentation

At this time, project planning has been completed and design has not yet started on the proposed project; however the City of Folsom anticipates that four design submittals will be prepared for the project. The 10% Design is will incorporate condition assessment work that will define the type of rehabilitation required for the various pipeline segments. Construction will occur during the low water demand period in the winter, therefore to meet that schedule, the City of Folsom will be releasing the advertising bid notice on less than 100% design and will provide the 100% design plan and specifications prior to accepting bids. During design, AWWA and ASTM Construction Standards, as well as City of Folsom Standard details and specifications will be followed along with any other applicable project design and material standards. This project is a rehabilitation project of existing infrastructure and will not result in any increase of capacity; therefore, this project is categorically exempt from environmental review under CEQA as noted in Title 14 - California Code of Regulations, Chapter 3 - Guidelines for Implementation of the California Environmental Quality Act, Article 19 - Categorical Exemptions, Section 15302 - Replacement or Reconstruction. The following permits are anticipated to be obtained for this project: An Amendment to the Public Water System Supply Permit issued to the City of Folsom is assumed to be required from the CDPH to incorporate the proposed repairs. As this project is a repair, the City of Folsom will work with the CDPH to determine if the amendment is necessary. An Amendment to the Waste Discharge Requirements for City of Folsom is expected to be required from the RWQCB due to discharges resulting from the repair work. As described above, the bid advertisement period for this period will be based on the 90% design. The 100% design will be distributed to contractors prior to accepting bids. Contract authorization by the

City Council will occur within two weeks of the bid opening. Work items include a pre-bid contractor's meeting, Bid Advertisement, Notice of Award (NOA)/NTP, and monthly progress reports.

The total estimated budget for this task is $399,960 (Required Cost Share: $250,000; Grant Share: $0; Additional Cost Share: $149,960). Direct expenses for permits are included under the "Other" category below.

Construction/Implementation

Details on the construction process are not currently available. Condition assessment work will define the type of lining/rehabilitation work (mortar lining, slip-lining, removing and replacing, etc.) required for the various lengths of the pipeline. Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Upon the NTP, the contractor will mobilize and prepare the site and staging area(s), and perform any necessary pre-construction surveys.

Project Construction

Following site preparation, the contractor will begin rehab/repair of the approximately 21,000 lineal foot Willow Hill Pipeline. This will also include rehab of up to 3,250 fittings, replacement of up to four flow meters, four control structures, and lining of an approximately 566,280 square-foot reservoir. As stated above, the type of repair (e.g. lining, replacement) will be determined during the condition assessment. During construction, the contractor will comply with all SWPPP requirements and any other monitoring and reporting requirements in the permits, as well as performing traffic control.

Performance Testing and Demobilization

After repair of the pipeline is complete, City of Folsom staff will perform inspections and testing of the rehabilitated pipeline according to manufacturer recommendations. In addition, the contractor will perform site clean-up and demobilize. Following final testing and startup (including leak testing as required), project certification will be performed.

The total estimated budget for this task is $6,466,170 (Required Cost Share: $2,350,000; Grant Share: $1,926,987; Additional Cost Share: $2,189,183).

Environmental Compliance/Mitigation/Enhancement

As previously mentioned, a Categorical Exemption is expected for this project; therefore, no mitigation measures are anticipated. This project will comply with any permit requirements and will follow the measures outlined in the SWPPP (if required for the project). Implementation of the approved Project Monitoring Plan will be performed under this task. Any benefits from the use of available water resulting from the water efficiency improvements will be addressed as a separate project.

The total estimated budget for this task is $12,800 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $12,800).

Construction Administration

Construction Administration includes Construction Management services and other construction administration services. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $304,440 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $304,440).

Other

This task includes preparing the Project Monitoring Plan and permits described above will be obtained.

The total estimated budget for this task is $5,485 ($525 PMP; $4,960 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $5,485)).

Construction/Implementation Contingency

A construction/implementation contingency of 5% will be used for the Willow Hill Pipeline Rehabilitation Project. The assumed contingency is less than other projects in the proposal due to the minimal open trenching expected as part of this project.

The total estimated budget for this task is $323,309 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $323,309).

PROJECT 12: LOWER AMERICAN RIVER MILE 0.5 AQUATIC RIPARIAN HABITAT ENHANCEMENT PROJECT

Project Description

The project has been developed to increase the frequency of flooded habitat available for fish in the American and Sacramento Rivers during the spring and winter and to provide improved riparian habitat for birds and other wildlife species. These enhancements would be achieved by lowering and re-grading the over-steepened river bank at the 3.3 acre site and improving the quality of the upland habitat on the adjacent elevated floodplain.

The total estimated budget for this project is $2,697,974 (Required Cost Share: $200,000; Grant Share: $1,408,183; Additional Cost Share: $1,089,791).

Direct Project Administration

The project has three implementing agencies: Sacramento Area Flood Control Agency (SAFCA), County of Sacramento, and Water Forum. SAFCA is the project sponsor and will be responsible for implementing the project. The County of Sacramento is the property owner, and Water Forum is a stakeholder in the project. Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the Lower American River Mile 0.5 Aquatic Riparian Enhancement Project. A project completion report will also be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $31,916 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $31,916).

Land Purchase/Easement

The land for the proposed project includes property purchased prior to 1984 by Sacramento County, a partner in this project. The County has calculated a market value of $22,000 per acre for the use of the American River Parkway for restoration by outside parties. This cost will either be waived or paid by SAFCA. For this project, the anticipated in-kind value for the use of the land is $21,460.

The total estimated budget for this task is $21,460. (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $21,460)

Planning/Design/Engineering/Environmental Documentation

Planning documents have been prepared to demonstrate the viability of the project. At this time the design of the project is at the 100% stage; however, designs will be updated to reflect changes in implementing agency, and a revised CEQA document will be circulated. An Environmental Assessment (EA) and Initial Study (IS) for CEQA and National Environmental Policy Act (NEPA) compliance were completed in December 2007 by USACE and a Notice of Determination (NOD) and Project Approval was completed May 2008. Because of the time that has passed and project changes involving the hauling and disposal of excavated soil, a new CEQA document will be released. This document will be a Supplemental EIR. This SEIR will supplement SAFCA's Natomas Levee Improvement Program (NLIP) EIR, because the soil will be hauled offsite for use in that project. In order to implement this project, the following permits will be required: Department of Fish and Game Section 1602 Streambed Alteration Agreement; Section 2081 California Endangered Species Act

Incidental Take Permit; Army Corps of Engineers 404 permit and Section 7 consultation for Clean Water Act and Federal Endangered Species Act compliance; RWQCB Section 401 Permit for water quality certification; CVFPB Encroachment Permit for permission to work in a floodway; State Lands Commission Lease for permission to work on state lands (if required); SWPPP will be prepared by the contractor as a condition of the contract.

Work items include advertising for bid, bid opening, reviewing the bids and issuing the NOA/NTP, as well as, the Construction Contract Award and will be performed by SAFCA staff. The Final Design Package will be used for the bid advertisement.

The total estimated budget for this task is $319,866 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $319,866).

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization, as described in the following sections.

Mobilization and Site Preparation

Upon the NTP, the contractor will mobilize its equipment and crew according to the staging plan. This will include moving equipment and materials to the site, grading and surfacing lay down and access roads as required and any temporary trailer, portable toilets and/or fencing required.

Project Construction

After site mobilization and site preparation, project construction will occur in two phases. In the first phase, elderberry shrubs that currently occupy approximately 2.5 of the 3.3 acres identified for floodplain habitat will be transplanted onto 10 acres of upland currently covered in non-native weedy grasses, blackberry vines, and a few native trees. Prior to transplanting, the site will be cleared and grubbed to prepare the upland area for the elderberry shrubs. The five acres will also be planted with elderberry seedlings and associated riparian species as established during consultation.
During the second construction phase, the existing bank at RM 0.5R will be reshaped to create fish and wildlife habitat. After the bank is reshaped, vegetation will be planted according to the planting plan. An irrigation system will be constructed to ensure establishment of the plantings, and a beaver exclusion fence installed along the shoreline to increase plant survival. As part of site clean-up, all equipment and excess materials will be transported offsite. Any disturbed areas outside the planting zones will be reseeded with native grasses to promote revegetation and minimize soil erosion. Finally, all work sites will be cleaned of all rubbish and all parts of the work will be left in a safe and neat condition suitable to the naturalistic and recreation setting of the Parkway. Cleared vegetation, organic debris, unused top soil and any trash will be removed from the site via truck and disposed at the Sacramento County landfill or other approved site. The estimated 60,000 cubic yards of soil material excavated during grading and shaping of the floodplain will be removed by truck and stockpiled at a property owned by SAFCA along the Garden Highway.

Performance Testing and Demobilization

The contractor will perform site clean-up and stabilization. This subtask also includes the preparation of record drawings, final inspection and project certification, and contractor demobilization. Plant establishment monitoring will continue after construction.

The total estimated budget for this task is $1,791,581 (Required Cost Share: $200,000; Grant Share: $1,408,183; Additional Cost Share: $183,398).

Environmental Compliance/Mitigation/Enhancement

An EA and IS for CEQA and NEPA compliance were completed in May 2008, resulting in a MND. All mitigation measures have been incorporated into the final design. Mitigation will be accomplished by avoiding sensitive resources through pre-construction surveys. Elderberries on the site will be transplanted per U.S. Fish and Wildlife Service requirements. Water quality will be protected via a SWPPP and BMPs, which will be the responsibility of the contractor. Implementation of an approved Project Monitoring Plan will be conducted as part of this task.

The total estimated budget for this task is $23,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $23,000).

Construction Administration

Construction Administration includes Construction Management services. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $143,326 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $143,326).

Other

This task includes preparing the Project Monitoring Plan and payment for permits described above.

The total estimated budget for this task is $8,508 ($525 PMP; $7,983 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $8,508)).

Construction/Implementation Contingency

A 20% construction/implementation contingency has been included. This rate is based on prior experience and engineering practice.

The total estimated budget for this task is $358,316 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $358,316).

PROJECT 13: LOWER COSUMNES RIVER FLOODPLAIN RESTORATION PROJECT

Project Description

The project will include levee breaching, re-creating historic sloughs and off-channel wetlands, and installing fish screens on existing water intake structures. The project will result in 143 acres of additional floodplain, riparian forest habitat and juvenile salmon rearing habitat.

The total estimated budget for this project is $2,557,195 (Required Cost Share: $100,000; Grant Share: $415,041; Additional Cost Share: $2,042,154).

Direct Project Administration

Administration includes communication with RWA and contractors, budget adjustments, and project status meetings. Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the Lower Cosumnes River Floodplain project. A project completion report will also be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $37,560 (Required Cost Share: $0; Grant Share: $37,560; Additional Cost Share: $0).

Land Purchase/Easement

No land purchases or easements are required for this project, and therefore, there are no associated costs in the budget.

Planning/Design/Engineering/Environmental Documentation

Ducks Unlimited completed the 10% design of the Lower Cosumnes Floodplain Restoration Project. The 100% (or final) design will be the design package that is used to advertise the bid for construction. The package will consist of the complete, signed plans and specifications. During design, AWWA and ASTM Construction Standards, OSHA regulations, and industry standard practice will be used as construction standards and health and safety standards. All other applicable project design and material standards will also be used. Environmental documentation has not yet been completed. A CEQA MND will be prepared. To comply with NEPA, an EA will also be developed; the EA will specifically help satisfy the federal Endangered Species Act and National Historic Preservation Act as required for federal funding currently being sought for the project. In order to implement this project, the following permits will be acquired: Department of Fish and Game Section 1600 Streambed Alteration Agreement for construction in the Cosumnes River. DFG is a partner on the Cosumnes River Preserve and will assist with development of the permit. U.S. Army Corps of Engineers Section 404 Encroachment permit for Clean Water Act and Federal Endangered Species Act compliance. RWQCB Section 401 Permit for water quality certification. CVFPB Encroachment Permit for permission to work on the levee. RWQCB Stormwater NPDES Permit for Construction. A SWPPP will be drafted by the contractor to help minimize the impacts of stormwater runoff from the construction site by documenting stormwater BMPs and for state environmental compliance. Permits will be prepared, submitted and acquired by Ducks Unlimited as an agent of the Bureau of Land Management (landowner).

The total estimated budget for this task is $626,432 (Required Cost Share: $100,000; Grant Share: $142,248; Additional Cost Share: $384,184).

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Upon the NTP, the contractor will mobilize its equipment and crew according to the staging plan and perform possible pre-construction surveys, including determining the presence of giant garter snakes as required for NEPA compliance.

Project Construction

During project construction, the construction contractor will excavate interior slough channels, construct interior access roads, and install fish exclusion screens on existing water intake structures. The levee will be breached in two locations to provide perennial and tidal connectivity between the river and the floodplain. From the breaches, a channel will be cut into the site to re-establish two historic tidal slough channels. Multiple slough side channels with varying elevations and small sub-floodplains will also be excavated off the two main channels. Inspection and testing will be performed on the constructed project by engineers from Ducks Unlimited, followed by revegetation and plant establishment. The construction contractor has sole and complete responsibility for the safety of all personnel and property on site for the project direction and will perform within OSHA and any other applicable codes, regulations, and ordinances.

Performance Testing and Demobilization

In this construction stage, the contractor will perform site clean-up and stabilization. Final inspection and project certification (which will be performed by engineers from Ducks Unlimited) will also be performed along with contractor demobilization. Inspections and project certification will be performed by Ducks Unlimited staff. After project completion, fish and water quality monitoring will be performed. Fish monitoring will identify and evaluate native fish use of the project site after completion. Specifically, the fish monitoring will examine the fall run Chinook Salmon, Sacramento Splittail, and Delta Smelt. Providing juvenile fish rearing habitat for these species is one of the primary goals of the project and monitoring will be used to assess ultimate success of the project. A specific fish monitoring protocol will be solicited/developed when project funding is secured. Water quality monitoring will include turbidity, salinity, nutrients both within the floodplain and the adjacent Cosumnes River upstream and downstream of the project site. A specific water quality monitoring protocol will be solicited/developed when the project funding is secured.

The total estimated budget for this task is $1,249,000 (Required Cost Share: $0; Grant Share: $224,683; Additional Cost Share: $1,024,317).

Environmental Compliance/Mitigation/Enhancement

A SWPPP will be developed and implemented as well as any mitigation measures identified in the approved MND and EA. The SWPPP BMPs will include seeding of all disturbed soil areas and equipment staging areas and other stormwater measures for post-construction project stabilization. Mitigation measures for CEQA and NEPA compliance are anticipated to consist of timing construction to occur during the non-breeding season for the Swainson’s Hawk and other birds, and monitoring sensitive flora and fauna species during project implementation. Cofferdams will also be constructed to prevent sedimentation and preserve water quality in the Cosumnes River during implementation of the project. Development and implementation of the SWPPP will be the responsibility of the contractor.

In addition, implementation of the approved Project Monitoring Plan will be covered under this task.

The total estimated budget for this task is $170,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $170,000).

Construction Administration

Construction Administration and management work items will be conducted under this task. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $41,472 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $41,472).

Other

This Task includes preparing the Project Monitoring Plan, monitoring of project benefits, public outreach, and obtaining permits described above.

The total estimated budget for this task is $307,831 (Required Cost Share: $0; Grant Share: $10,550; Additional Cost Share: $297,281).

Construction/Implementation Contingency

An approximately 10% construction/implementation contingency has been included for this project. This value was chosen due to the stage of the project as well as experience with past projects.

The total estimated budget for this task is $124,900 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $124,900).

PROJECT 14: LOWER COSUMNES RIVER INTEGRATED GROUNDWATER RECHARGE PROJECT

Project Description

This project will include an 80+-acre spreading basin to be constructed and maintained by Omochumne-Hartnell Water District (OHWD) adjacent to the Cosumnes River and recharge groundwater with up to 4,000 AF/year of Rancho Murieta Community Services District (RMCSD) surface water and construct a recovery well with an estimated capacity of 600 gpm for RMCSD to reduce supply deficits. The well will increase supply to RMCSD by an estimated average annual of 300 AF. For grant management purposes, the project has been divided into two project elements – Lower Consumnes River Integrated Groundwater Recharge Project (Project 14) and Lower Consumnes River Integrated Groundwater Recovery Project (Project 17). The groundwater recharge aspect of the project sponsored by OHWD is described below.

The total estimated budget for this project is $1,489,675 (Required Cost Share: $50,000; Grant Share: $986,668; Additional Cost Share: $453,007).

Direct Project Administration

Administration includes Board communications, budget adjustments, project status meetings, communication with RWA and contractors, and between the two participating agencies, OHWD and RMCSD. Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the project. A completion report will also be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $26,544 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $26,544).

Land Purchase/Easement

The proposed location of the project is not owned by OHWD. OHWD and the land owner are currently working toward developing a lease agreement for an initial 10-year period with an option for an additional 10-years, ensuring a 20-year lifetime on the spreading basin.

The total estimated budget for this task is $75,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $75,000).

Planning/Design/Engineering/Environmental Documentation

Conceptual design (10% design) of the project has been completed; additional design deliverables will be prepared and submitted as part of the project. All materials used and procedures followed will conform to ASTM designations, State specifications, and other applicable engineering standards such as American Society of Civil Engineers (ASCE), AWWA. OHWD will draft, submit and adopt an IS and MND. Construction permits will include a U.S. Army Corps of Engineers Section 404 Encroachment Permit, a California Department of Fish and Game Section 1601 Permit, and compliance with the State's General NPDES Permit for Stormwater Discharges during construction will be required. A project bid package will be prepared and a contractor will be secured through a competitive selection process.

The total estimated budget for this task is $306,048 (Required Cost Share: $25,000; Grant Share: $206,048; Additional Cost Share: $75,000).

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Mobilization and site preparation for this project will include pre-construction surveys; grubbing and clearing for site access; prepping of the staging area, spreading basin site, diversion unit site and pipeline route; and the implementation of any required mitigation actions. Site preparation also includes designation of staging areas and grading access ramps to diversion unit site near the Cosumnes River and to the spreading basin to meet the existing levee road, and winterization of the site(s) in October in anticipation of winter season.

Project Construction

OHWD is proposing to install a new pump station and intake on the right bank of the Cosumnes River near River Mile 22, upstream of Blodgett Dam. The new pump would draw water from a wet well placed in a river bank area that is hydraulically connected to the river. A culvert would connect this wet well to the intake structure on the river. The intake structure would screen the diversion to protect fishery resources (fish screen or infiltration gallery). The pump will be designed to draw up to 30 cfs of water. The pumping unit would consist of the wet well caisson, a water pump, and electric motors. Pump and motor controls will be installed on a platform above the wet well. The platform will be placed above the 100-year flood levels. Power sources for the lift station and fish screen would be installed by Sacramento Municipal Utility District (SMUD) as part of this project.
OHWD would also install about 600 feet of pipeline to convey the water from the pumping unit to the spreading basin. Existing soils in the project area will be tested to determine its suitability as a backfill around the pipeline and levee protection features. Pressure relief and vacuum valves would be installed to provide pipeline protection. A riprap outflow structure will be constructed in the spreading basin to dissipate energy from water flow and provide protection against soil erosion. The spreading basin would be constructed to allow infiltration of water; removal of top soil will improve the infiltration rates and will provide earth material needed for constructing berms around the basin. A monitoring well, with up to four nested piezometers, would also be completed as part of the Phase 1 project within the spreading basin to assess groundwater impacts. Field experience during drilling will determine the final monitoring well design.

Performance Testing and Demobilization

Following project construction, performance testing will be performed on new facilities. This includes a percolation test on the new spreading basin, leakage tests performed on all pipes, followed by full system flow tests conducted in the pipelines after the system is operational. Testing and demonstration of diversion pumps and associated electrical components, valves, gauges and other mechanical equipment will also be performed.

The total estimated budget for this task is $835,000 (Required Cost Share: $25,000; Grant Share: $735,000; Additional Cost Share: $75,000).

Environmental Compliance/Mitigation/Enhancement

Little environmental mitigation or enhancement actions beyond normal construction BMPs are expected to be required for the project. A SWPPP will also be prepared and implemented as part of project construction; thus only standard stormwater BMPs will be implemented through the construction period. Implementation of an approved Project Monitoring Plan will be included as part of this task.

The total estimated budget for this task is $4,800 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $4,800).

Construction Administration

Construction Administration includes Construction Management services. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $65,876 (Required Cost Share: $0; Grant Share: $45,620; Additional Cost Share: $20,256).

Other

This task includes preparing the Project Monitoring Plan and securing of permits noted above.

The total estimated budget for this task is $9,407 ($525 PMP; $8,882 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $9,407)).

Construction/Implementation Contingency

A construction/implementation contingency of 20% has been included and is based on prior experience and the early stage of the project.

The total estimated budget for this task is $167,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $167,000).

PROJECT 15: SLEEPY HOLLOW DETENTION BASIN RETROFIT PROJECT

Project Description

This project will modify an existing 6.3 acre flood detention basin using low impact development techniques such as the development of perennial channels to treat summer irrigation flows, seasonal wetland areas to treat large storm flows and winter runoff, habitat heterogeneity through creation of riparian clusters and habitat mounds. The basin will also be used to increase recharge from stormwater.

The total estimated budget for this project is $973,384 (Required Cost Share: $0; Grant Share: $222,345; Additional Cost Share: $751,039).

Direct Project Administration

The City of Elk Grove will be the lead agency on this project, but the project will be implemented cooperatively with Laguna Creek Watershed Council (LCWC), the Sheldon Community Association, and with local, well organized grass-roots community groups. Labor compliance will be implemented under an approved LCP. Quarterly reports will be prepared assessing the progress and accomplishments of the Sleepy Hollow Detention Basin Retrofit Project. A project completion report will also be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $14,118 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $14,118).

Land Purchase/Easement

Morrison Homes Inc. completed the Sleepy Hollow Unit 2 subdivision in 2005. The conditions of approval required the developer to dedicate the lots containing the detention basin to the City of Elk Grove, so land purchase/easement is not required.

Planning/Design/Engineering/Environmental Documentation

Four design submittals are expected to be completed for this project. The 100% Design will be used to advertise the project for bid for construction and will consist of the complete and signed specifications.

The proposed retrofit design must not compromise the primary objective of the detention basin: 100-year storm event flood control protection. Construction material will only include temporary irrigation pipes and equipment to be used for a minimum of five years to help establish the plantings. Conveyance of stormwater will be achieved by created drainage swales and no piping will be required. An environmental analysis for CEQA compliance has not yet been completed; however, a MND will be completed. Permitting requirements will be identified and considered during project design. A California Department of Fish and Game Section 1602 Streambed Alteration Agreement. Compliance with the State's General Stormwater NPDES Permit for construction will also be required. A SWPPP will be developed by the contractor and implemented. A U.S. Army Corps of Engineers Section 404 Encroachment Permit for construction in U.S. Waters; if a Section 404 Permit is sought, then a Central Valley RWQCB Section 401 Permit for water quality certification will also be required. The dry wells will be registered with the United States Environmental Protection Agency Underground Injection Control Program. A project bid package will be prepared and a contractor will be secured through a competitive selection process.

The total estimated budget for this task is $143,226 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $143,226).

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

The contractor will mobilize their equipment and crew according to the pre-designated staging plan. Mobilization and site preparation includes clearing a path to the work area, creating a temporary staging area, and mobilizing large construction equipment to the site. Additionally, the contractor will install temporary construction fencing, stormwater management controls, and clear and grub the site.

Project Construction

For project construction, the contractor will retrofit the new multi-purpose basin. This will include grading for wetland creation and habitat enhancement, constructing five Darcy Columns (dry wells), constructing and installing irrigation piping, and constructing recreational trails. In addition, trees and shrubs will be planted, and interpretive signs will be placed.

Performance Testing and Demobilization

Following project construction, the contractor will perform site clean-up and fencing. This work phase also includes final inspection and project certification. Lastly, the contractor will demobilize all equipment to complete construction.

The total estimated budget for this task is $263,400 (Required Cost Share: $0; Grant Share: $222,345; Additional Cost Share: $41,055).

Environmental Compliance/Mitigation/Enhancement

The Sleepy Hollow Detention Basin Retrofit Project is an environmental enhancement project; as such, it is anticipated that there will be no environmental mitigations required beyond standard construction mitigation measures. All measures described in the SWPPP and any permits will be followed. Also included in this task is implementation of the approved Project Monitoring Plan.

The total estimated budget for this task is $357,500 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $357,000).

Construction Administration

Construction Administration and Construction Management work items will be conducted under this task. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $61,435 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $61,435).

Other

Other tasks include baseline monitoring, community engagement and preparation of the Project Monitoring Plan.

Baseline monitoring will consist of a water quality assessment of the storm runoff coming into the basin and discharging from the basin. The Baseline Monitoring Plan Report will evaluate existing incoming and discharge water quality conditions to measure against post-construction conditions, and it will also summarize the hydrology of basin and groundwater percolation capacity.
The City desires to engage the adjacent community through at least one workshop to let them know about the Project and the City's intentions. The City will advertise the workshops, prepare presentations, host the workshops, gather input, address issues and communicate with the community.

The total estimated budget for this task is $81,025 ($525 PMP; $5,500 permits; $10,000 community outreach; $40,000 baseline monitoring; $25,000 Sacramento County fees (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $81,025)).

Construction/Implementation Contingency

A construction/implementation contingency of 20% has been included. This contingency value was selected based on the development of the project and previous experience with similar projects.

The total estimated budget for this task is $52,680 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $52,680).

PROJECT 16: ANTELOPE CREEK INTEGRATED WATER EFFICIENCY PROJECT

Project Description

This is a multi-objective water efficiency and regional flood control improvement project proposed within the Dry Creek Watershed area of the American River Basin. This project includes the first phase of a two-phase project. The first phase includes the concrete gunite lining and other improvements of the Antelope Creek/Canal and its tributaries and the construction of one (in a future series of two) on-channel flood control weirs on Antelope Creek. The project will conserve up to 125 AF per year, reduce the amount of erosion in the watershed, improve water quality and reduce peak flow from a 100-year storm event by 530 cubic feet second on Antelope Creek near Atlantic Street in the City of Roseville. For grant management purposes, the project has been split into two project elements (Antelope Creek Integrated Flood Control Project and Antelope Creek Integrated Water Efficiency Project). The Antelope Creek Integrated Water Efficiency Project sponsored by Placer County Water Agency is described below.

The total estimated budget for this project is $536,416 (Required Cost Share: $20,130; Grant Share: $379,468; Additional Cost Share: $136,818).

Direct Project Administration

Administration includes Board communications, budget adjustments, project status meetings, and communication with RWA and contractors and communication between the two participating agencies, Placer County Water Agency (PCWA) and Placer County Flood Control and Water Conservation District (District). Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the project. A completion report will also be prepared at the end of the project, as well as, annual reporting.

The total estimated budget for this task is $25,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $25,000).

Land Purchase/Easement

The canal lining portions of the project area will be submitted to the PCWA Property Specialist to determine existing PCWA easements and if other easements will need to be obtained.

The total estimated budget for this task is $15,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $15,000).

Planning/Design/Engineering/Environmental Documentation

Planning documents have been prepared to demonstrate the viability of the project. At this time, the project has completed the conceptual (10%) design stage. During design, AWWA and ASTM Construction Standards and OSHA regulations and industry standard practice will be used as construction standards and health and safety standards. PCWA anticipates filing a Negative Declaration for CEQA compliance for the project. It is not expected that permits will be required for the project, but it may need to comply with a SWPPP.

The total estimated budget for this task is $20,000 (Required Cost Share: $5,130; Grant Share: $0; Additional Cost Share: $14,870).

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

Upon receipt of the NTP, the contractor and PCWA crews will begin mobilization and site preparation activities. These activities will include selective clearing and grubbing of debris and invasive species within the construction areas and following all prescribed SWPPP measures.

Project Construction

For canal outlets, PCWA staff will shape the area with hand tools and off-road construction equipment, install rip-rap or other material to dissipate the energy of the flowing water, install filter fabric and other devices as needed to prevent erosion, and install reinforcing wire where needed. The outside contractor will “shoot” the gunite, following direction from PCWA staff.
For raising canal walls, PCWA staff will shape the canal with hand tools and off-road construction equipment, increase the height of the canal wall with either material excavated from the canal or with temporary walls made from boards, and install reinforcing wire to the bottom and sides of the canal. Following canal lining, when the gunite has cured and hardened, each canal outlet will be opened and allowed to flow at a flow rate that would be typical of a stormwater flow. The effectiveness of the energy dissipater will be evaluated for its ability to reduce the velocity of the water and reduce the amount of sediment transported. Turbidity samples will be taken at the canal outlet and at the point where the flow enters a natural or manmade water way utilizing a portable Turbidity meter.
The precise number of sites and locations to receive improvements will be identified in the project planning and design phase and will be provided to DWR prior to commencing with the construction phase of the project.

The total estimated budget for this task is $407,468 (Required Cost Share: $15,000; Grant Share: $379,468; Additional Cost Share: $13,000).

Environmental Compliance/Mitigation/Enhancement

All personnel associated with this project will observe and comply with the PCWA *Natural Resources Management Training Manual* BMPs. A Project Monitoring Plan will be prepared for this project to direct longer-term project monitoring to ensure successfully project implementation and operation.

The total estimated budget for this task is $30,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $30,000).

Construction Administration

Construction Administration includes Construction Management services and other administrative activities relating to project implementation. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $10,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $10,000).

Other

This task includes preparing the Project Monitoring Plan and includes an estimate budget for any permits that are not yet identified.

The total estimated budget for this task is $5,575 ($525 PMP; $5,050 permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $5,575)).

Construction/Implementation Contingency

A construction/implementation contingency of 5% will be used for this project, which is based on previous projects and the relatively simple nature of the construction activities for this project.

The total estimated budget for this task is $23,373 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $23,373).

PROJECT 17: LOWER COSUMNES RIVER INTEGRATED GROUNDWATER RECOVERY PROJECT

Project Description

This project will include an 80+-acre spreading basin to be constructed and maintained by Omochumne-Hartnell Water District (OHWD) adjacent to the Cosumnes River and recharge groundwater with up to 4,000 AF/year of Rancho Murieta Community Services District (RMCSD) surface water and construct a recovery well with an estimated capacity of 600 gpm for RMCSD to reduce supply deficits. The well will increase supply to RMCSD by an estimated average annual of 300 AF. For grant management purposes, the project has been divided into two project elements – Lower Consumnes River Integrated Groundwater Recharge Project (Project 14) and Lower Consumnes River Integrated Groundwater Recovery Project (Project 17). The groundwater recovery aspect of the project sponsored by RMCSD is described below.

The total estimated budget for this project is $1,033,265 (Required Cost Share: $20,130; Grant Share: $494,097; Additional Cost Share: $519,038).

Direct Project Administration

Administration includes Board communications, budget adjustments, project status meetings, communication with RWA and contractors, and between the two participating agencies, OHWD and RMCSD. Labor compliance will be implemented under an approved LCP. Following execution of the grant agreement, quarterly reports will be prepared assessing the progress and accomplishments of the project. A project completion report will also be prepared at the end of the project, as well, as annual reporting.

The total estimated budget for this task is $34,430 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $34,430).

Land Purchase/Easement

The proposed location of the project is not owned by RMCSD. The proposed well location is within an easement dating back to 1995; however, portions of the transmission pipeline will be outside of the existing easement, so new easement extensions will need to be negotiated.

The total estimated budget for this task is $50,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $50,000).

Planning/Design/Engineering/Environmental Documentation

All materials used and procedures followed will conform to ASTM designations, State specifications, and other applicable engineering standards such as ASCE, AWWA and California Water Well Standards. RMCSD will prepare and adopt an IS/MND for the project. Minimal impacts are anticipated and a MND will subsequently be completed and adopted for the water rights portion of the project. A Sacramento County Well Permit will be required. Compliance with the State's General NPDES Permit for Stormwater Discharges during construction will also be required. For operation of the project, a California Division of Water Rights Additional Point of Diversion permit will be required to allow the diversion of water from the stream to the spreading basins and a CDPH approval will be required to amend the RMCSD's water supply permit to allow the new water supply. The project will be split into two bid packages: one bid package will be for construction of well head facilities including

plumbing, pump and electrical controls; and the second bid package will be for construction of the transmission pipeline.

The total estimated budget for this task is $170,000 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $170,000).

Construction/Implementation

Construction is divided into three categories: mobilization and site preparation, project construction, and performance testing and demobilization.

Mobilization and Site Preparation

This includes an onsite meeting with the construction contractor and equipment mobilization to the project location.

Project Construction

The new well will be installed on westerly edge of RMCSD's service area on agriculture lands. The new well will be constructed of 12- to 16-inch diameter steel casing with stainless steel screen, between 500 and 600 feet in depth. The well and associated well head facilities will be designed to pump between 500 and 600 gpm. The pumping unit would consist of an above-grade water pump and electric motor set on a platform. The platform will be placed above the 100-year flood level. Power sources would be installed by Sacramento Municipal Utility District (SMUD) as part of this project. Also as part of the construction, RMCSD will install approximately 5,000 feet of 10-inch pipeline to convey the water from the well site to the existing distribution system for a direct connection. Existing soils in the project area will be tested to determine its suitability as a backfill around the pipeline, and backfill will be augmented by select imported material for the pipe bedding and pipe zone, as appropriate for the type of pipe installed. Backflow valves will be installed to provide well protection.

Performance Testing and Demobilization

This will include start-up and operation testing of the well and demobilization from the site by the contractor.

The total estimated budget for this task is $665,000 (Required Cost Share: $20,130; Grant Share: $494,097; Additional Cost Share: $150,773).

Environmental Compliance/Mitigation/Enhancement

Little environmental mitigation or enhancement actions beyond normal construction BMPs are expected to be required for the project. A SWPPP will also be prepared and implemented as part of project construction; thus only standard stormwater BMPs will be implemented through the construction period. An approved Project Monitoring Plan will be included as part of this task.

The total estimated budget for this task is $4,800 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $4,800).

Construction Administration

Construction Administration includes Construction Management services. Management includes: review of contractor's schedule; management and coordination; maintenance of detailed project records; review and distribution of submittals; and construction inspection.

The total estimated budget for this task is $33,250 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $33,250).

Other

This task includes preparing the Project Monitoring Plan and securing of permits noted above.

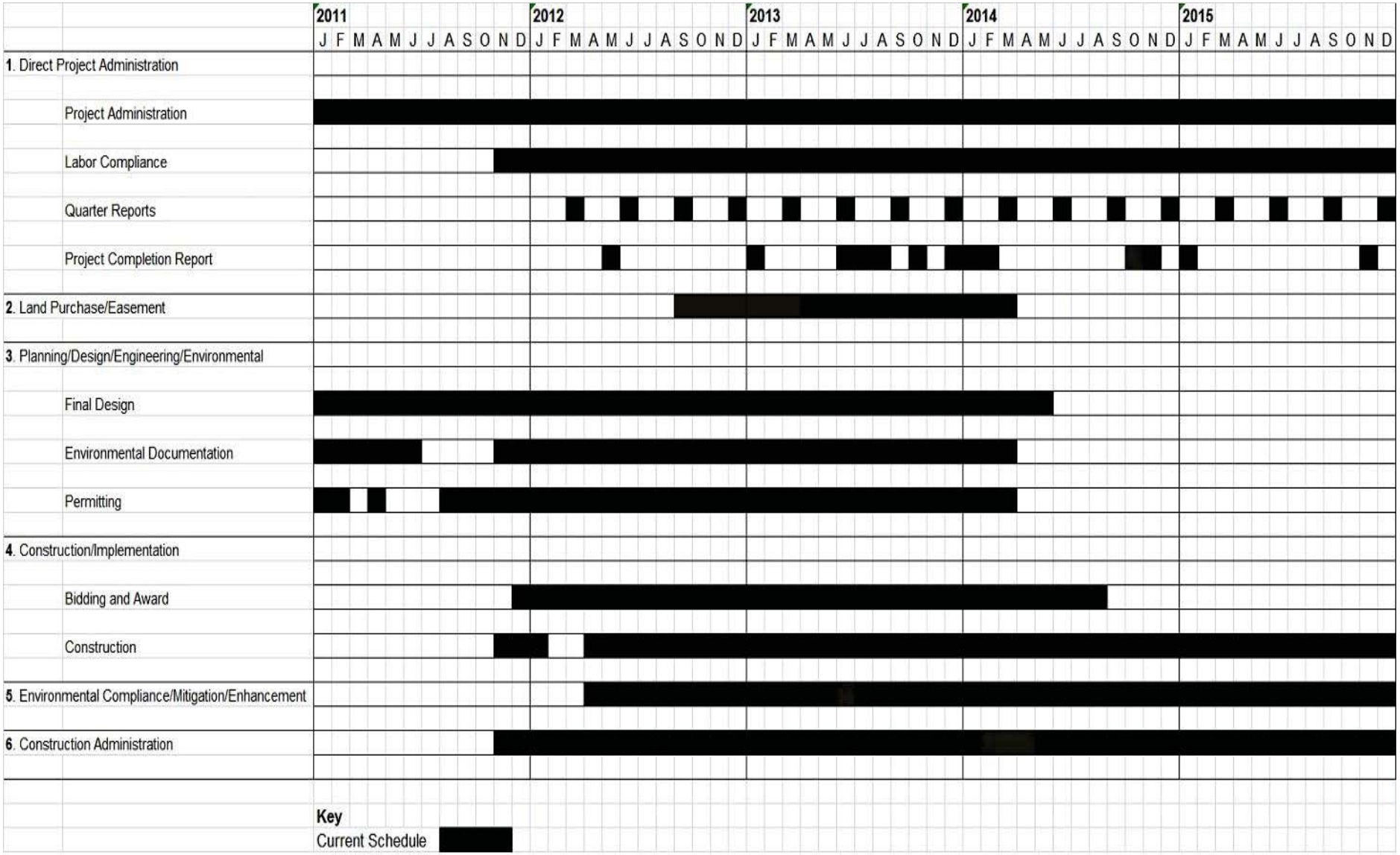
The total estimated budget for this task is $9,285 ($525 PMP; $1,000 County permits; $7,760 other permits (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $9,285)).

Construction/Implementation Contingency

A construction/implementation contingency of 20% has been included and is based on prior experience and the early stage of the project.

The total estimated budget for this task is $66,500 (Required Cost Share: $0; Grant Share: $0; Additional Cost Share: $66,500).

EXHIBIT B
SCHEDULE



Note: See Section 17. Submission of Reports – Quarterly Progress Reports: detailed individual project schedules will be provided with quarterly progress reports.

EXHIBIT C
BUDGET

RWA Proposition 84 Implementation Program Budget Summary

Project #	Project Name	Implementing Agency	DWR Grant Amount	Total Project Cost	"Required" Cost Share	Reviewed Costs (Grant Share + Required Cost Share)	"Additional" Non-Reviewed Cost Share	Other State Funding
1	City of Roseville ASR Program - Phase 2	City of Roseville	$ 1,976,397	$ 4,437,513	$ 750,000	$ 2,726,397	$ 1,711,116	
2	Secret Ravine Fish Passage Improvement Project	City of Roseville and Dry Creek Conservancy	$ 311,051	$ 366,551	$ -	$ 311,051	$ 55,500	$ 55,500
3	E. A. Fairbairn Groundwater Well	City of Sacramento	$ 988,198	$ 1,578,454	$ 100,000	$ 1,088,198	$ 490,256	
4	Shasta Park Reservoir and Well Project	City of Sacramento	$ 988,199	$ 13,609,693	$ 5,400,000	$ 6,388,199	$ 7,221,494	
5	Antelope Creek Integrated Flood Control Improvement Project	Placer County Flood Control and Water Conservation District	$ 741,149	$ 1,519,699	$ 100,000	$ 841,149	$ 678,550	
6	Regional Water Meter Retrofit Acceleration Project **(Water Conservation Project)**	Regional Water Authority	$ 913,095	$ 959,545	$ -	$ 913,095	$ 46,450	
7	Regional Indoor and Outdoor Water Efficiency Project **(Water Conservation Project)**	Regional Water Authority	$ 988,198	$ 1,004,439	$ -	$ 988,198	$ 16,241	
8	Recycled Water for the SMUD Co-Generation Facility	Sacramento Regional County Sanitation District (SRCSD)	$ 1,547,519	$ 9,165,994	$ 2,700,000	$ 4,247,519	$ 4,918,475	
9	North Antelope Booster Pump Station	Sacramento Suburban Water District	$ 261,873	$ 918,412	$ 200,000	$ 461,873	$ 456,539	
10	Coyle Avenue and Roseview Park Pump Stations and Water Treatment Systems Project	Sacramento Suburban Water District	$ 1,482,298	$ 5,706,162	$ 1,800,000	$ 3,282,298	$ 2,423,864	
11	Willow Hill Pipeline Rehabilitation Project	City of Folsom	$ 1,926,987	$ 7,606,671	$ 2,600,000	$ 4,526,987	$ 3,079,684	
12	Aquatic and Riparian Habitat Enhancement in the Lower American River at River Mile 0.5R	Sacramento Area Flood Control Agency	$ 1,408,183	$ 2,697,974	$ 200,000	$ 1,608,183	$ 1,089,791	
13	Lower Cosumnes River Floodplain Restoration Project	Ducks Unlimited	$ 415,041	$ 2,557,195	$ 100,000	$ 515,041	$ 2,042,154	
14	Lower Cosumnes River Integrated Groundwater Recharge Project	Omochumne-Hartnell Water District	$ 986,668	$ 1,489,675	$ 50,000	$ 1,036,668	$ 453,007	
15	Sleepy Hollow Detention Basin Retrofit	City of Elk Grove	$ 222,345	$ 973,384		$ 222,345	$ 751,039	
16	Antelope Creek Integrated Water Efficiency Project	Placer County Water Agency	$ 379,468	$ 536,416	$ 20,130	$ 399,598	$ 136,818	
17	Lower Cosumnes River Integrated Groundwater Recovery Project	Rancho Murieta Community Services District	$ 494,097	$ 1,033,265	$ 20,130	$ 514,227	$ 519,038	
		Grand Total	**$ 16,030,766**	**$ 56,161,041**	**$ 14,040,260**	**$ 30,071,026**	**$ 26,090,015**	

EXHIBIT D
STANDARD CONDITIONS

D.1 ACCOUNTING AND DEPOSIT OF GRANT DISBURSEMENT:

a) **SEPARATE ACCOUNTING OF GRANT DISBURSEMENT AND INTEREST RECORDS**: Grantee shall account for the money disbursed pursuant to this Grant Agreement separately from all other Grantee funds. Grantee shall maintain audit and accounting procedures that are in accordance with generally accepted accounting principles and practices, consistently applied. Grantee shall keep complete and accurate records of all receipts, disbursements, and interest earned on expenditures of such funds. Grantee shall require its contractors or subcontractors to maintain books, records, and other documents pertinent to their work in accordance with generally accepted accounting principles and practices. Records are subject to inspection by State at any and all reasonable times.

b) **FISCAL MANAGEMENT SYSTEMS AND ACCOUNTING STANDARDS:** The Grantee agrees that, at a minimum, its fiscal control and accounting procedures will be sufficient to permit tracing of grant funds to a level of expenditure adequate to establish that such funds have not been used in violation of state law or this Grant Agreement.

c) **REMITTANCE OF UNEXPENDED FUNDS:** Grantee, within a period of sixty (60) calendar days from the final disbursement from State to Grantee of grant funds, shall remit to State any unexpended funds that were disbursed to Grantee under this Grant Agreement and were not needed to pay Eligible Project Costs.

D.2 ACKNOWLEDGEMENT OF CREDIT: Grantee shall include appropriate acknowledgement of credit to the State and to all cost-sharing partners for their support when promoting the Project or using any data and/or information developed under this Grant Agreement. During construction of the Project, Grantee shall install a sign at a prominent location which shall include a statement that the Project is financed under the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006, administered by State of California, Department of Water Resources. Grantee shall notify State that the sign has been erected by providing them with a site map with the sign location noted and a photograph of the sign.

D.3 AMENDMENT: No amendment or variation of the terms of this Grant Agreement shall be valid unless made in writing, signed by the parties and approved as required. No oral understanding or agreement not incorporated in the Grant Agreement is binding on any of the parties. For guidance on the Amendment Requirements see Exhibit H.

D.4 AMERICANS WITH DISABILITIES ACT: By signing this Grant Agreement, Grantee assures State that it complies with the Americans with Disabilities Act (ADA) of 1990, (42 U.S.C., 12101 *et seq*.), which prohibits discrimination on the basis of disability, as well as all applicable regulations and guidelines issued pursuant to the ADA.

D.5 AUDITS: State reserves the right to conduct an audit at any time between the execution of this Grant Agreement and the completion of the Project, with the costs of such audit borne by State. After completion of the Project, State may require Grantee to conduct a final audit, at Grantee's expense, such audit to be conducted by and a report prepared by an independent Certified Public Accountant. Failure or refusal by Grantee to comply with this provision shall be considered a breach of this Grant Agreement, and State may take any action it deems necessary to protect its interests.

Pursuant to Government Code Section 8546.7, the parties shall be subject to the examination and audit of State for a period of three years after final payment under this Grant Agreement with respect of all matters connected with this Grant Agreement, including but not limited to, the cost of administering this Grant Agreement. All records of Grantee or subcontractors shall be preserved for this purpose for at least three (3) years after Project completion. See Exhibit H for a listing of documents/records that State Auditors would need to review in the event of a grant being audited.

D.6 BUDGET CONTINGENCY: LIMIT ON STATE FUNDS. Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 is subject to the availability of funds including any mandates from the Department of Finance, the Pooled Money Investment Board or any other state

authority. The State will not make payments of any kind, including advances or reimbursements, until funding is made available by the State Treasurer.

D.7 CHILD SUPPORT COMPLIANCE ACT: For any Grant Agreement in excess of $100,000, the Grantee acknowledges in accordance with Public Contract Code 7110, that:

a) The Grantee recognizes the importance of child and family support obligations and shall fully comply with all applicable state and federal laws relating to child and family support enforcement, including, but not limited to, disclosure of information and compliance with earnings assignment orders, as provided in Chapter 8 (commencing with section 5200) of Part 5 of Division 9 of the Family Code; and
b) The Grantee, to the best of its knowledge is fully complying with the earnings assignment orders of all employees and is providing the names of all new employees to the New Hire Registry maintained by the California Employment Development Department.

D.8 COMPETITIVE BIDDING AND PROCUREMENTS: Grantee shall comply with all applicable laws and regulations regarding securing competitive bids and undertaking competitive negotiations in Grantee's contracts with other entities for acquisition of goods and services and construction of public works with funds provided by State under this Grant Agreement.

D.9 COMPUTER SOFTWARE: The Grantee certifies that it has appropriate systems and controls in place to ensure that state funds will not be used in the performance of this Grant Agreement for the acquisition, operation, or maintenance of computer software in violation of copyright laws.

D.10 CONFLICT OF INTEREST

a) **Current State Employees**: No State officer or employee shall engage in any employment, activity, or enterprise from which the officer or employee receives compensation or has a financial interest and which is sponsored or funded by any State agency, unless the employment, activity, or enterprise is required as a condition of regular State employment. No State officer or employee shall contract on his or her own behalf as an independent contractor with any State agency to provide goods or services.
b) **Former State Employee:** For the two-year period from the date he or she left State employment, no former State officer or employee may enter into a contract in which he or she engaged in any of the negotiations, transactions, planning, arrangements, or any part of the decision-making process relevant to the contract while employed in any capacity by any State agency. For the twelve-month period from the date he or she left State employment, no former State officer or employee may enter into a contract with any State agency if he or she was employed by that State agency in a policy-making position in the same general subject area as the proposed contract within the twelve-month period prior to his or her leaving State service.

D.11 DELIVERY OF INFORMATION, REPORTS, AND DATA: The Grantee agrees to expeditiously provide, during work on the Project and throughout the term of this Grant Agreement, such reports, data, information, and certifications as may be reasonably required by the State.

D.12 DISPOSITION OF EQUIPMENT: Grantee shall provide to State, not less than 30 days prior to submission of the final project invoice, a final inventory list of equipment purchased with grant funds provided by State. Grantee shall consult with State on the scope of the inventory not less than 60 days prior to the submission of the final project invoice. The inventory shall include all items with a current estimated fair market value of more than $5,000 per item. Within 60 days of receipt of such inventory, State shall provide Grantee with a list of the items on the inventory that State will take title to. All other items shall become the property of Grantee. State shall arrange for delivery from Grantee of items that it takes title to. Cost of transportation, if any, shall be borne by State.

D.13 DISPUTES: In the event of an invoice dispute, payment will not be made until the dispute is resolved and a corrected invoice submitted. Failure to use the address exactly as provided may result in return of the invoice to the Grantee. Payment shall be deemed complete upon deposit of the payment, properly addressed, postage prepaid, in the United States mail. Any claim that Grantee may have regarding the performance of this Grant Agreement including, but not limited to claims for additional compensation or extension of time, shall be submitted to the Director, Department of Water Resources, within thirty (30)

calendar days of Grantee's knowledge of the claim. State and Grantee shall then attempt to negotiate a resolution of such claim and process an amendment to the Grant Agreement to implement the terms of any such resolution.

D.14 DRUG-FREE WORKPLACE CERTIFICATION

Certification of Compliance: By signing this Grant Agreement, Grantee, its contractors or subcontractors hereby certify, under penalty of perjury under the laws of State of California, compliance with the requirements of the Drug-Free Workplace Act of 1990 (Government Code 8350 *et seq*.) and have or will provide a drug-free workplace by taking the following actions:

a) Publish a statement notifying employees, contractors, and subcontractors that unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited and specifying actions to be taken against employees, contractors, or subcontractors for violations, as required by Government Code Section 8355(a).
b) Establish a Drug-Free Awareness Program, as required by Government Code Section 8355(b) to inform employees, contractors, or subcontractors about all of the following:
    1. The dangers of drug abuse in the workplace,
    2. Grantee's policy of maintaining a drug-free workplace,
    3. Any available counseling, rehabilitation, and employee assistance programs, and
    4. Penalties that may be imposed upon employees, contractors, and subcontractors for drug abuse violations.
c) Provide as required by Government Code Sections 8355(c), that every employee, contractor,and/or subcontractor who works under this Grant Agreement:
    1. Will receive a copy of Grantee's drug-free policy statement, and
    2. Will agree to abide by terms of Grantee's condition of employment, contract or subcontract.

D.15 FINAL INSPECTIONS AND CERTIFICATION OF REGISTERED CIVIL ENGINEER: Upon completion of a construction project and as determined by State, Grantee shall provide for a final inspection and certification by a California Registered Civil Engineer that the project has been completed in accordance with submitted final plans and specifications and any modifications thereto and in accordance with this Grant Agreement and to the State's satisfaction.

D.16 GOVERNING LAW: This Grant Agreement is governed by and shall be interpreted in accordance with the laws of the State of California.

D.17 GRANTEE COMMITMENTS: Grantee accepts and agrees to comply with all terms, provisions, conditions, and commitments of this Funding Agreement, including all incorporated documents, and to fulfill all assurances, declarations, representations, and statements made by Funding Recipient in the application, documents, amendments, and communications filed in support of its request for California Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act of 2006 financing.

D.18 INCOME RESTRICTIONS: The Grantee agrees that any refunds, rebates, credits, or other amounts (including any interest thereon, accruing to or received by the Grantee under this Grant Agreement shall be paid by the Grantee to the State, to the extent that they are properly allocable to costs for which the Grantee has been reimbursed by the State under this Grant Agreement.

D.19 INDEPENDENT CAPACITY: Grantee, and the agents and employees of Grantee, if any, in the performance of the Grant Agreement, shall act in an independent capacity and not as officers, employees, or agents of the State.

D.20 INSPECTIONS: State shall have the right to inspect the work being performed at any and all reasonable times, providing a minimum of a 24-hour notice, during the term of the Grant Agreement. This right shall extend to any local project sponsor, subagreements, and Grantee shall include provisions ensuring such access in all its contracts or sub-contractors entered into pursuant to its Grant Agreement with State. Grantee acknowledges that Project documents may be subject to the Public Records Act (California Government Code Section 6250 et. seq.). State shall have the right to inspect these documents at any and all reasonable times after completion of the Project to ensure compliance with the terms and conditions of

this Grant Agreement. During regular office hours, State shall have the right to inspect and to make copies of any books, records, or reports of the Grantee relating to this Grant Agreement. Grantee shall maintain and shall make available at all times for such inspection accurate records of its costs, disbursements, and receipts with respect to its activities under this Grant Agreement. Failure or refusal by Grantee to comply with this provision shall be considered a breach of this Grant Agreement, and State may withhold disbursements to Grantee or take any other action it deems necessary to protect its interests.

D.21 NONDISCRIMINATION: During the performance of this Grant Agreement, Grantee and its contractors shall not unlawfully discriminate, harass, or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, physical disability (including HIV and AIDS), mental disability, medical condition (cancer), age (over 40), marital status, and denial of family care leave. Grantee and contractors shall ensure that the evaluation and treatment of their employees and applicants for employment are free from such discrimination and harassment. Grantee and contractors shall comply with the provisions of the Fair Employment and Housing Act (Government Code Section 12990 (a-f) *et seq*.) and the applicable regulations promulgated there under (California Code of Regulations, Title 2, Section 7285 *et seq*.). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code Section 12990 (a-f), set forth in Chapter 5 of Division 4 of Title 2 of the California Code of Regulations, are incorporated into this Grant Agreement by reference and made a part hereof as if set forth in full. Grantee and its contractors shall give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement. Grantee shall include the nondiscrimination and compliance provisions of this clause in all contracts to perform work under the Grant Agreement.

D.22 NO THIRD PARTY RIGHTS: The parties to this Grant Agreement do not intend to create rights in, or grant remedies to, any third party as a beneficiary of this Grant Agreement, or of any duty, covenant, obligation or undertaking established herein.

D.23 OPINIONS AND DETERMINATIONS: The parties agree that review or approval of any IRWM Program applications, documents, permits, plans and specifications or other program information by the State is for administrative purposes only and does not relieve the Grantee of its responsibility to properly plan, design, construct, operate, maintain, implement, or otherwise carry out the IRWM Program.

D.24 PERMITS, LICENSES, APPROVALS, AND LEGAL OBLIGATIONS. Grantee shall be responsible for obtaining any and all permits, licenses, and approvals required for performing its obligations under this Grant Agreement. Grantee shall comply with the California Environmental Quality Act (PRC Section 21000 *et seq*.) and other applicable federal, State, and local laws, rules, and regulations, guidelines, and requirements prior to disbursement of funds under this Grant Agreement.

Without limiting the foregoing, Funding Recipient shall keep informed of and take all measures necessary to ensure compliance with California Labor Code requirements, including but not limited to Section 1720 *et seq*. of the California Labor Code regarding public works, limitations on use of volunteer labor (California Labor Code Section 1720.4), labor compliance programs (California Labor Code Section 1771.5), and payment of prevailing wages for work done under this Funding Agreement. Pursuant to the provisions of Proposition 84, the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006, Cal. Pub. Res. Code § 75076 *et seq*., the Funding Recipient must have a labor compliance program that meets the requirements of California Labor Code Section 1771.5.

D.25 PROHIBITION AGAINST DISPOSAL OF PROJECT WITHOUT STATE PERMISSION: Grantee and Local Project Sponsors shall not sell, abandon, lease, transfer, exchange, mortgage, hypothecate, or encumber in any manner whatsoever all or any portion of any real or other property necessarily connected or used in conjunction with the IRWM Program without prior permission of State. Grantee and Local Project Sponsors shall not take any action concerning the performance of this Grant Agreement, including but not limited to actions relating to user fees, charges, and assessments that could adversely affect the ability of Grantee to meet its obligations under this Grant Agreement, without prior written permission of State. State may require that the proceeds from the disposition of any real or personal property acquired with funds disbursed under this Grant Agreement be remitted to State.

D.26 REMEDIES, COSTS, AND ATTORNEY FEES: The Grantee agrees that any remedy provided in this Grant Agreement is in addition to and not in derogation of any other legal or equitable remedy available to the State as a result of breach of this Grant Agreement by the Grantee, whether such breach occurs before or after completion of the Project, and exercise of any remedy provided by this Grant Agreement by the State shall not preclude the State from pursuing any legal remedy or right which would otherwise be available. In the event of litigation between the parties hereto arising from this Grant Agreement, it is agreed that the prevailing party shall be entitled to such reasonable costs and/or attorney fees as may be ordered by the court entertaining such litigation.

D.27 RETENTION: Notwithstanding any other provision of this Grant Agreement, State shall, for each project, withhold five percent (5.0%) until January 1, 2016 and ten percent (10.0%), thereafter, of the funds requested by Grantee for reimbursement of Eligible Costs. Each project in this Grant Agreement will be eligible to release its respective retention when that project is completed and Grantee has met requirements of Paragraph 17, "Submissions of Reports" as follows. At such time as the "Project Completion Report" required under Paragraph 17 is submitted to and approved by State, State shall disburse the retained funds as to that project to Grantee, except in the case of the last project to be completed under this Grant Agreement, in which case retention for such project will not be disbursed until the "Grant Completion Report" is submitted to and approved by State.

D.28 RIGHTS IN DATA: To the extent permitted by law, the Grantee agrees that all data, plans, drawings, specifications, reports, computer programs, operating manuals, notes, and other written or graphic work produced in the performance of this Grant Agreement shall be in the public domain. The Grantee may disclose, disseminate and use in whole or in part, any final form data and information received, collected, and developed under this Grant Agreement, subject to appropriate acknowledgement of credit to the State for financial support. The Grantee shall not utilize the materials for any profit-making venture or sell or grant rights to a third party who intends to do so.

D.29 SEVERABILITY OF UNENFORCEABLE PROVISION: If any provision of this Grant Agreement is held invalid or unenforceable by a court of final jurisdiction, all other provisions of this Grant Agreement shall be construed to remain fully valid, enforceable, and binding on the parties.

D.30 STATE REVIEWS AND INDEMNIFICATION: The parties agree that review or approval of Project applications, documents, permits, plans and specifications or other Project information by the State is for administrative purposes only and does not relieve the Grantee or Local Project Sponsors of their responsibility to properly plan, design, construct, operate, maintain, implement, or otherwise carry out the Project. To the extent permitted by law, the Grantee and Local Project Sponsors agree to indemnify, defend and hold harmless the State and the State against any loss or liability arising out of any claim or action brought against the State from and against any and all losses, claims, damages, liabilities or expenses, of every conceivable kind, character and nature whatsoever arising out of, resulting from, or in any way connected with:

a) The Project or the conditions, occupancy, use, possession, conduct or management of, work done in or about, or the planning, design, acquisition, installation, or construction, of the Project or any part thereof;
b) Performing any of the terms contained in this Grant Agreement or any related document;
c) Any violation of any applicable law, rule or regulation, any environmental law (including, without limitation, the Federal Comprehensive Environmental Response, Compensation and Liability Act, the Resource Conservation and Recovery Act, the California Hazardous Substance Account Act, the Federal Water Pollution Control Act, the Clean Air Act, the California Hazardous Waste Control Law and CWC Section 13304, and any successors to said laws), rule or regulation or the release of any toxic substance on or near the natural water system; or
d) Any untrue statement or alleged untrue statement of any material fact or omission or alleged omission to state a material fact necessary to make the statements required to be stated therein, in light of the circumstances under which they were made, not misleading with respect to any information provided by the Grantee for use in any disclosure document utilized in connection with any of the transactions contemplated by this Grant Agreement. Grantee agrees to pay and discharge any judgment or award entered or made against the State with respect to any such claim or action, and any settlement,

compromise or other voluntary resolution. The provisions of this section shall survive the term of the Grant Agreement.

D.31 SUCCESSORS AND ASSIGNS: This Grant Agreement and all of its provisions shall apply to and bind the successors and assigns of the parties. No assignment or transfer of this Grant Agreement or any part thereof, rights hereunder, or interest herein by the Grantee shall be valid unless and until it is approved by State and made subject to such reasonable terms and conditions as State may impose.

D.32 TIMELINESS: Time is of the essence in this Grant Agreement.

D.33 TRAVEL: Grantee agrees that travel and per diem costs shall NOT be eligible for reimbursement with State funds, and shall NOT be eligible for computing Grantee cost match. Travel includes the costs of transportation, subsistence, and other associated costs incurred by personnel during the term of this Grant Agreement.

D.34 WAIVER OF RIGHTS: None of the provisions of this Grant Agreement shall be deemed waived unless expressly waived in writing. It is the intention of the parties here to that from time to time either party may waive any of its rights under this Grant Agreement unless contrary to law. Any waiver by either party of rights arising in connection with the Grant Agreement shall not be deemed to be a waiver with respect to any other rights or matters, and such provisions shall continue in full force and effect.

EXHIBIT E
REPORT FORMAT AND REQUIREMENTS

The following reporting formats should be utilized. Please obtain State approval prior to submitting a report in an alternative format.

QUARTERLY PROGRESS REPORT

Grantee shall submit Quarterly Progress Reports on a consistent basis to meet the State's requirement for disbursement of funds. The quarterly progress report should describe the work performed during the reporting period. For each project, describe the work performed including:

CONTINUING ELIGIBILITY

- A brief summary of the status of adoption of an IRWM Plan that complies with Part 2.2 of Division 6 of the CWC commencing with Section 10530.
- In areas that receive water supplied from the Sacramento-San Joaquin Delta, the IRWM Plan must reduce dependence on the Sacramento-San Joaquin Delta for water supply (SB 855 (Stats. 2010) Section 31(c)(1)(B)).
- Discuss the reasonable and feasible efforts to engage DAC into your IRWM efforts in regards to planning and projects that support their critical water supply or water quality needs.

PROJECT INFORMATION (INCLUDE ANY OF THE BELOW THAT WERE APPLICABLE DURING THE REPORTING PERIOD)

- Legal matters.
- Engineering matters.
- Environmental matters.
- Status of permits, easements, rights-of-way, and approvals as may be required by other State, federal, and/or local agencies.
- Major accomplishments during the quarter (i.e. tasks completed, milestones met, meetings held or attended, press releases, etc).
- Discussion of data submittal effort(s) for the previous quarter, including a description of the data submitted and date(s) of submittal.
- Issues/concerns that have, will, or could affect the schedule or budget, with a recommendation on how to correct the matter.
- Description of any differences between the work performed and the work outlined in the project work plans.
- Description of any efforts to update IRWM Plan to obligations listed in Paragraph 12, "Continuing Eligibility, if applicable."

COST INFORMATION

- Provide a List showing all costs incurred during the quarter by the grantee, the Local Project Sponsor overseeing the work, and each contractor working on the project. The list should include for all non-construction, or implementation costs, (i.e., design, and admin charges) the hours per task worked on during the quarter for above personnel.
- A discussion on how the actual budget is progressing in comparison to the project budget included in the Work Plan.
- A revised budget, including an explanation of why the revisions were necessary, by task, if changed from latest budget shown in Appendix C, Budget. Note, a revised budget may require an official amendment to the Agreement before it is accepted as final.

SCHEDULE INFORMATION

- A schedule showing actual progress verse planned progress as shown in Exhibit B.
- A discussion on how the actual schedule is progressing in comparison to the schedule in Exhibit B.
- A revised schedule, by task, if changed from latest schedule in Exhibit B. Note, a revised schedule may require an official amendment to the Agreement before it is accepted as final.

ANTICIPATED ACTIVITIES NEXT QUARTER

- Provide a description of anticipated activities for the next quarterly reporting period.

PROJECT COMPLETION REPORT

A Project Completion Report is required for each project identified in the Work Plan, Exhibit A. This report will include the following Sections:

EXECUTIVE SUMMARY

The Executive Summary consists of a maximum of ten (10) pages summarizing project information (see report status section below for topics). The Executive Summary should include the following:

- Brief description of work proposed to be done in the original Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 IRWM Implementation Grant application.
- Description of actual work completed and any deviations from the work plan identified in the Grant Agreement. List any official amendments to the Agreement, with a short description of the amendment
- Describe the mechanism or process that allows for continued performance monitoring of the projects in meeting the objectives of the IRWM Plan.

REPORTS AND/OR PRODUCTS

- Provide a copy of any final technical report or study, produced for this project as described in the Work Plan, if applicable.
- Provide a map and shapefile(s) showing the location of the completed project. A description of the geographic projection and datum used for the shapefile must be submitted with the shapefile (a NAD '83 datum and either a UTM 10 or UTM 11 projection, dependent on the project's location in the state, should be utilized).
- If any wells were constructed as part of the project, provide the following information: well logs; borehole geophysical logs; state well number; site information to include horizontal (NAD '83) and vertical (NAVD '88) datum to be determined within 0.5 feet.
- Provide an electronic copy of any as-built plans (media: CD-ROM; PDF format).
- Provide copies of any data collected along with location maps.
- If applicable, describe the findings of any study and whether the study determined the engineering, hydrologic, hydrogeologic, environmental, economic and financial feasibility of the project.
- If applicable, a discussion of the critical water supply or water quality benefits to DAC as part of this Grant Agreement.

COST & DISPOSITION OF FUNDS INFORMATION

- A list of invoices showing:
  - The date each invoice was submitted to State.
  - The amount of the invoice.
  - The date the check was received.
  - The amount of the check (If a check has not been received for the final invoice, then state this in this section).

- A spreadsheet summary of the original budget costs by task versus the final project costs

- A summary of final funds disbursement including:
  - Labor cost of personnel of agency/ major consultant /sub-consultants (Indicate personnel, hours, rates, type of profession and reason for consultant, i.e., design, CEQA work, etc).
  - Construction cost information, shown by material, equipment, labor costs, and change orders.
  - Any other incurred cost detail.
  - A statement verifying separate accounting of grant disbursements.
- Summary of project cost including:
  - Accounting of the cost of project expenditure.
  - Include all internal and external costs not previously disclosed.
  - A discussion of factors that positively or negatively affected the project cost and any deviation from the original project cost estimate.

ADDITIONAL INFORMATION

- Benefits derived from the project, with quantification of such benefits provided, if applicable.
- A final project schedule showing actual progress verse planned progress.
- Certification from a California Registered Civil Engineer that the project was conducted in accordance with the approved work plan and any approved modifications thereto.
- Submittal schedule for the Post Performance Report and an outline of the proposed reporting format.

GRANT COMPLETION REPORT

The Grant Completion Report shall generally use the following format. This format may be modified as necessary to effectively communicate information on the various projects in the IRWM Program funded by this Grant Agreement, and includes the following:

EXECUTIVE SUMMARY

The Executive Summary consists of a maximum of twenty (20) pages summarizing information for the grant as well as the individual projects.

REPORTS AND/OR PRODUCTS

- Summary of the regional priorities, objectives, and water management strategies of the IRWM Plan.
- Brief comparison of work proposed in the original Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 IRWM Implementation Grant application and actual work done.
- Brief description of the projects completed and how they will further the goals identified in the Agency's final approved IRWM Plan.
- Describe how the implemented projects will meet the regional priorities identified in the final approved IRWM Plan and how the projects contribute to regional integration.
- Identify remaining work and mechanism for their implementation.
- Identify any changes to the IRWM Plan as result of project implementation.
- Short description of the two year IRWM Plan update and the date when the updated Plan was submitted to DWR.
- If applicable, a short discussion on how the IRWM Plan will assist in reducing dependence on Delta water supplies.
- A discussion of the critical water supply or water quality benefits to DAC as part of this Grant Agreement

COST & DISPOSITION OF FUNDS INFORMATION

- A summary of final funds disbursement for each project.

ADDITIONAL INFORMATION

- A final schedule showing individual project's actual progress duration verse planned progress.
- Certification from a California Registered Civil Engineer that the Program was conducted in accordance with the approved work plan and any approved modifications thereto. Discussion of the synergies of the completed projects, including the integration of project benefits and a comparison of actual benefits versus those discussed in the original proposal.
- Submittal schedule for the Post Performance Reports for each of the projects in this Grant Agreement.

POST-PERFORMANCE REPORT

Post Performance Report is required annually for every project for a period of 10 years beginning after the first year of operation, and includes the following:

REPORTS AND/OR PRODUCTS

- Time period of the annual report, i.e., Oct 2014 through September 2015.
- Short project description.
- Brief discussion of the project benefits to water quality, water supply, and the environment.
- An assessment of any explanations for any differences between the expected versus actual project benefits in meeting IRWM priorities as stated in the original IRWM Implementation Grant application. Where applicable, the reporting should include quantitative metrics, i.e., new acre-feet of water produced that year, acres of wildlife habitat added, etc.
- Summary of any additional costs and/or benefits deriving from the project since its completion, if applicable.
- Continued reporting on meeting the Output Indicators and Targets discussed in the Project Monitoring Plan discussed in Paragraph 22 of this Grant Agreement.
- Any additional information relevant to or generated by the continued operation of the project.

ELECTRONIC REPORT FORMATTING

Grantee agrees that work funded under this Grant Agreement will be provided in an electronic format to State. Electronic submittal of final reports, plans, studies, data, and other work performed under this grant shall be as follows:

- Text preferably in MS WORD or text PDF format.

- Files generally less than 10 MB in size.

- Files named so that the public can determine their content. For example, file naming of reports must have the title and, if subdivided into smaller sized files, the chapter number/letter and names in the report Table of Content (TOC); files of maps, figures, and tables by number/letter as referenced in the TOC; well logs files with DWR-required naming convention; and Appendix number/letter and named in the TOC.

- For projects involving a modeling component, grantee shall provide the major input data files, parameters, calibration statistics, output files, and other information requested by State's Project Manager.

EXHIBIT F
LOCAL PROJECT SPONSORS

LOCAL PROJECT SPONSORS

Grantee has assigned, for each project, a Local Project Sponsor according to the roles of the participating agencies identified in the IRWM Plan. Local Project Sponsors may act on behalf of Grantee for the purposes of individual project management, oversight, compliance, and operations and maintenance. Local Project Sponsors are identified for each Sponsored Project below:

Local Sponsor Agency Designations		
Sponsored Project	Sponsor Agency	Agency Address
Project 1 - City of Roseville ASR Program – Phase 2	City of Roseville	2005 Hilltop Circle Roseville, CA 95747
Project 2 - Secret Ravine Fish Passage Improvement Project	City of Roseville and Dry Creek Conservancy	2005 Hilltop Circle Roseville, CA 95747
Project 3 - E. A. Fairbairn Groundwater Well	City of Sacramento	1395 35th Avenue Sacramento, CA 95822
Project 4 - Shasta Park Reservoir and Well Project	City of Sacramento	1395 35th Avenue Sacramento, CA 95822
Project 5 - Antelope Creek Integrated Flood Control Improvement Project	Placer County Flood Control and Water Conservation District	3091 County Center Drive, Suite 220 Auburn, CA 95603
Project 6 - Regional Water Meter Retrofit Acceleration Project	Regional Water Authority	5620 Birdcage Street, Suite 180 Citrus Heights, CA 95610
Project 7 - Regional Indoor and Outdoor Water Efficiency Project	Regional Water Authority	5620 Birdcage Street, Suite 180 Citrus Heights, CA 95610
Project 8 - Recycled Water for the SMUD Co-Generation Facility	Sacramento Regional County Sanitation District (SRCSD)	10060 Goethe Road Sacramento, CA 95827
Project 9 - North Antelope Booster Pump Station	Sacramento Suburban Water District	3701 Marconi Ave #100 Sacramento, CA 95821-5346
Project 10 - Coyle Avenue and Roseview Park Pump Stations and	Sacramento Suburban Water District	3701 Marconi Ave #100 Sacramento, CA 95821-5346

Water Treatment Systems Project		
Project 11 - Willow Hill Pipeline Rehabilitation Project	City of Folsom	50 Natoma Street Folsom, CA 95630
Project 12 - Aquatic and Riparian Habitat Enhancement in the Lower American River at River Mile 0.5R	Sacramento Area Flood Control Agency	1007 7th Street, 7th Floor Sacramento, CA 95814
Project 13 - Lower Cosumnes River Floodplain Restoration Project	Ducks Unlimited	3074 Gold Canal Drive Rancho Cordova, CA 95670
Project 14 - Lower Cosumnes River Integrated Groundwater Recharge Project	Omochumne-Hartnell Water District	P.O. Box 211 Wilton, CA 95693
Project 15 - Sleepy Hollow Detention Basin Retrofit	City of Elk Grove	8401 Laguna Palms Way Elk Grove, CA 95758
Project 16 - Antelope Creek Integrated Water Efficiency Project	Placer County Water Agency	144 Ferguson Rd Auburn, CA 95603
Project 17 - Lower Cosumnes River Integrated Groundwater Recovery Project	Rancho Murieta Community Services District	15160 Jackson Road Rancho Murieta, CA 95683

EXHIBIT G
REQUIREMENTS FOR DATA SUBMITTAL

SURFACE AND GROUNDWATER QUALITY DATA:
Groundwater quality and ambient surface water quality monitoring data that include chemical, physical, or biological data shall be submitted to the State as described below, with a narrative description of data submittal activities included in project reports, as described in Exhibit E.

Surface water quality monitoring data shall be prepared for submission to the California Environmental Data Exchange Network (CEDEN). The CEDEN data templates are available on the CEDEN website. Inclusion of additional data elements described on the data templates is desirable. Data ready for submission should be uploaded to your CEDEN Regional Data Center via the CEDEN website. CEDEN website: http://www.ceden.org.

If a project's Work Plan contains a groundwater ambient monitoring element, groundwater quality monitoring data shall be submitted to the State for inclusion in the State Water Resources Control Board's Groundwater Ambient Monitoring and Assessment (GAMA) Program Information on the GAMA Program can be obtained at: http://www.waterboards.ca.gov/water_issues/programs/gama/. If further information is required, the Grantee can contact the State Water Resources Control Board (SWRCB) GAMA Program. A listing of SWRCB staff involved in the GAMA program can be found at:
http://www.swrcb.ca.gov/water_issues/programs/gama/contact.shtml

GROUNDWATER LEVEL DATA
For each project that collects groundwater level data, Grantee will need to submit this data to DWR's Water Data Library (WDL), with a narrative description of data submittal activities included in project reports, as described in Exhibit E. Information regarding the WDL and in what format to submit data in can be found at: http://wdl.water.ca.gov/.

In the near future, DWR's WDL will be replaced by the California Statewide Groundwater Elevation Monitoring program (CASGEM). Once this Program comes online Grantee will then submit groundwater level data to CASGEM. Information regarding the CASGEM program can be found at:
http://www.water.ca.gov/groundwater/casgem/

Exhibit H
State Audit Document Requirements and Guidelines for Grantees Under DWR Financial Assistance Programs

The following provides a list of documents typically required by State Auditors and general guidelines for Grantees. List of documents pertains to both Grant funding and Grantee's Funding Match and details the documents/records that State Auditors would need to review in the event of this Grant Agreement is audited. Grantees should ensure that such records are maintained for each funded project.

List of Documents for Audit

Internal Controls:
1. Organization chart (e.g., Agency's overall organization chart and organization chart for this Grant Agreement's funded projects.
2. Written internal procedures and flowcharts for the following:
    a. Receipts, deposits and disbursements
    b. State reimbursement requests
    c. Grant expenditure tracking
    d. Guidelines, policy, and procedures on grant funded Program/Project
3. Audit reports of the Agency internal control structure and/or financial statements within the last two years.
4. Prior audit reports on grant funded Program/Project.

Agreements and Contracts:
1. Original signed Grant Agreement, any amendment(s) and budget modification documents.
2. A listing of all bond-funded grants received from the State.
3. A listing of all other funding sources for each project.
4. All subcontractor and consultant contracts and related or partners documents, if applicable.
5. Contracts between the Agency and member agencies as related to this grant agreement.

Invoices:
1. Invoices from vendors and subcontractors for expenditures submitted to the State for payments under this Grant Agreement.
2. Documentation linking subcontractor invoices to State reimbursement, requests and related budget line items under this Grant Agreement.
3. Reimbursement requests submitted to the State for this Grant Agreement.

Cash Documents:
1. Receipts (copies of warrants) showing payments received from the State.
2. Deposit slips (or bank statements) showing deposit of the payments received from the State.
3. Cancelled checks or disbursement documents showing payments made to vendors, subcontractors, consultants, and/or agents under this Grant Agreement.
4. Bank statements showing the deposit of the receipts.

Accounting Records:
1. Ledgers showing entries for receipts and cash disbursements.
2. Ledgers showing receipts and cash disbursement entries of other funding sources.
3. Bridging documents that tie the general ledger to requests for grant reimbursement.

Administration Costs: Supporting documents showing the calculation of administration costs.

Personnel:
1. List of all contractors and Agency staff that worked on this grant funded Program/Project.
2. Payroll records including timesheets for contractor staff and the Agency personnel who provided services charged to this Grant Agreement.

Project Files:
1. All supporting documentation maintained in the project files.
2. All correspondence related to this Grant Agreement.

General Grant Agreement Guidelines

Amendment Requirements:
Amendments to the Work Plan, Budget, and/or Schedule of this Grant Agreement are triggered when the proposed changes are deemed by the State to be substantial. Substantial changes generally include changes to the wording/scope of work, schedule or term, and budget. For example, a formal budget change to an Agreement is required when the culmination of the proposed Grant amount budget change(s) for a Task is greater than 10% of the original Grant amount budget for that particular Task or the Task to be exchanged.

Funding Match Contribution
Funding Match (often referred to as Grantee Cost Share) is the amount defined in Paragraph 4 of this Agreement. Funding Match consists of non-State funds including in-kind services. In-kind services are defined as work performed (i.e., dollar value of non-cash contributions) by the Grantee (and potentially other parties involved) directly related to the execution of the scope of work (*examples*: volunteer services, equipment use, and facilities). The cost of which in-kind service is valued can counted as funding match in-lieu of actual funds (or revenue) provided by the Grantee. Other funding match and in-kind service eligibility conditions apply (see paragraph 9). Provided below is guidance for claiming funding match with and without in-kind services.

1. Adequate documentation supporting value of in-kind service (or volunteer service) as funding match claimed shall be maintained. Although tracked separately, in-kind services shall be documented and, to the extent feasible, supported by the same methods used by the Grantee for its own employees. Provide formal (on official letterhead) and substantial documentation of in-kind service by including the following:
   - Describe contributed item(s) or service(s)
   - Purpose for which contribution was made (tie to scope of work)
   - Name of contributing organization and date of contribution
   - Real or approximate value of contribution. Who valued the contribution and how was the value determined? (e.g., actual, appraisal, fair market value, etc.). Justification of rate. (see item #4, below)
   - Person's name and function of the contributing person
   - Hours of contribution
   - If multiple sources exist, summarize these on a table with summed charges
   - Was contribution provided by, obtained with, or supported by government funds? If so, indicate source.

2. Funding match contribution (including in kind services) shall be for costs and services directly attributed to activities included in this Grant Agreement Work Plan. These services, furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as in-kind if the activities are an integral and necessary part of this Grant Agreement. Evaluate eligibility with DWR Project Manager in advance of submittal.

3. Do not track cash contributions made to a project as an expenditure as you would for an in-kind service. When providing funding match, track cash contributions to the Project (i.e. revenues) and expenditures (typically in-kind contribution) separately in an accounting system.

4. Rates for volunteer or in-kind services shall be consistent with those paid for similar work in the Grantee organization. For example, volunteer service of clearing vegetation performed by an attorney shall be valued at a fair market value for this service, not the rate for professional legal services. In those instances in which the required skills are not found in the recipient organization, rates shall be consistent with those paid for similar work in the labor market. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.

EXHIBIT I
GRANTEE RESOLUTION

RESOLUTION NO. 2011-01
A RESOLUTION OF THE REGIONAL WATER AUTHORITY BOARD OF DIRECTORS AUTHORIZING SUBMITTAL OF AN INTEGRATED REGIONAL WATER MANAGEMENT IMPLEMENTATION GRANT APPLICATION AND ENTERING INTO A GRANT AGREEMENT

WHEREAS, the Regional Water Authority ("Authority") was formed to serve and represent regional water supply interests and to assist in protecting and enhancing the reliability, availability, affordability and quality of water resources; and

WHEREAS, the Authority has committed to preparing and implementing an Integrated Regional Water Management Plan ("IRWMP") to ensure maintaining water supplies for all uses in a sustainable environment; and

WHEREAS, the Authority adopted the American River Basin IRWMP in May 2006 and is completing a comprehensive update to ensure compliance with revised IRWMP guidelines released by the California Department of Water Resources in July 2010;

WHEREAS, the Authority is a public agency that serves as the Regional Water Management Group representing numerous stakeholders and interests throughout the region; and

WHEREAS the Authority has conducted extensive stakeholder outreach to identify priority IRWMP projects that provide multiple, integrated benefits throughout the region;

NOW, THEREFORE, be it resolved by the Board of Directors of the Authority as follows:

1. The Executive Director of RWA is hereby authorized and directed to prepare the necessary data, make investigations, execute and file an application with the California Department of Water Resources to obtain an Integrated Regional Water Management Implementation Grant pursuant to the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Bond Act of 2006 (Public Resources Code Section 75001 *et seq.*).

2. The Executive Director of RWA is hereby authorized to enter into an agreement with the California Department of Water Resources to accept the grant.

PASSED AND ADOPTED at a meeting of the Authority held on January 13, 2011.

By: _____
Chair, Regional Water Authority

Attest: _____
Clerk, Regional Water Authority

Grant Agreement
No. 4600009678

Attachments Due

Complete and submit
with Sealed Proposal

City of SACRAMENTO
Department of Utilities

ATTACHMENT B

Certification of Non-Segregated Facilities

[Note: This certification is required by 41 CFR 60-1.8 (b) and/or as required by the May 9. 1967 Order (32 F.R. 7439, May 19, 1967) and is applicable to all _____ assisted construction contracts and subcontracts with a price exceeding $10,000 which are not exempt from the Equal Opportunity Clause.]

The federally assisted construction contractor certifies that he does not maintain or provide for his Employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor certifies further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor agrees that a breach of this certification is a violation of the Equal Opportunity Clause in this contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise.

The federally assisted construction contractor agrees that (except where he has obtained identical certifications from proposed subcontractors for specified time period) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the Equal Opportunity Clause, and that he will retain such certifications in his files.

Contractor Name **License Number**

Name & Title of Authorized Representative

Signature **Date**

Note: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001

City of SACRAMENTO
Department of Utilities

ATTACHMENT C

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion
- Prime Contractors and Subcontractors -

(1) The contractor certifies, by submission of this proposal, that it and its principals:
   (a). Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by any Federal agencies;
   (b). Have not Within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them or commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
   (c). Are not presented indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and
   (d). Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

(2) Where the contractor is unable to certify to any of the statements in this certification, such contractor shall attach an explanation to this proposal.

*Exceptions will not necessarily result in denial of award, but will be considered in determining bidder responsibility. For any exception noted, indicate to whom it applies, initiating agency, dates of action, and the type of violation.

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification is made under penalty of perjury under the laws of the State of California.

Contractor Name **License Number**

Name & Title of Authorized Representative

Signature **Date**

Revised February 5, 2016

City of SACRAMENTO
Department of Utilities

ATTACHMENT J

Non-Discrimination Clause

(1) During the performance of this contract, contractor and its subcontractors shall not unlawfully discriminate against any employee or applicant for employment because of race, religion, color, national origin, ancestry, physical handicap, medical condition, marital status, age (over 40) or sex. Contractors and subcontractors shall insure that the evaluation and treatment of their employees and applicants for employment are free of such discrimination. Contractors and subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Government Code Section 12900 et seq.) and the applicable regulations promulgated thereunder (California Administrative Code, Title 2, Section 7285.0 et seq.). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code, Section 12900, set forth in Chapter 5 of Division 4 of Title 2 or the California Administrative Code are incorporated into this contract by reference and made a part hereof as if set forth in full. Contractor and its subcontractor shall give written notice of their obligations under this clause to labor organizations with which they have a collective, bargaining or other agreement.

(2) This contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under the contract.

THE UNDERSIGNED CERTIFIES THAT THE CONTRACTOR WILL COMPLY WITH THE ABOVE REQUIREMENTS.

Contractor Name **License Number**

Name & Title of Authorized Representative

Signature **Date**

City of SACRAMENTO
Department of Utilities

ATTACHMENT K

Non-Collusion Affidavit

TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID

State of California
County of_____

_____being first duly sworn, deposes and says that he or she is

_____ of _____ the party

making the foregoing bid, that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference, with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the :proposed contract; that all statements contained in the bid are true; and, further, that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof the effectuate a collusive or sham bid.

Contractor Name **License Number**

Name & Title of Authorized Representative

Signature **Date**

*Note: Public Contracts Code 7106 requires this non-collusion affidavit be submitted with a bid for any public works contract of a: public entity.

SPECIAL PROVISIONS

SHASTA PARK WATER FACILITY
TECHNICAL SPECIFICATIONS

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SECTION 01105

GENERAL INFORMATION AND REQUIREMENTS

PART 1 - GENERAL

1.01 GOVERNING DOCUMENTS

A. All work performed under this Contract shall be in accordance with the following General Conditions:

1. Sealed Proposal
2. Agreement
3. City of Sacramento-Standard Specification - June 2007 (hereinafter CSSS) Sections 1 through 8, including Addenda No. 1 and No. 2.

B. All work performed under this Contract shall be in accordance with the following Special Provisions:

1. Technical Specifications
2. Contract Drawings
3. CSSS - Sections 10 through 38
4. Payment Bond
5. Performance Bond
6. California Labor Code- Chapter 4 of Division 3

C. In the event of a conflict in the Contract Documents, priorities, as appropriate, set forth below shall govern:

1. General Conditions
2. Technical Specifications
3. Contract Drawings
4. CSSS
5. Conflicts:
   a. In case of conflict within the Drawings involving quantities, furnish the greater quantity.
   b. In case of conflict within the Special Provisions involving quality of material or procedure, furnish the higher quality material and procedure.
   c. Where provisions of codes, safety orders, Contract Documents, referenced manufacturer's specifications or industry standards are in conflict, the more restrictive and higher quality shall govern.

1.02 DEFINITIONS

A. For definitions not found herein, refer to CSSS, Section 1.

B. "City" shall mean the City of Sacramento.

C. “Engineer” shall mean the Director of Utilities or his designated representative.

D. “Calendar Day” shall mean every day shown on the calendar, Sundays and holidays included.

E. “Working Day” see CSSS, Section 1, definition 1-34, page 1(4).

F. “Contract Documents” shall mean the General Conditions identified in Paragraph 1.01.A and the Special Provisions identified in Paragraph 1.01.B of this Section.

G. “Drawings” or “Plans” shall mean the Contract Drawings.

H. “Provide” shall mean furnish and install, in accordance with the drawings.

I. “Addenda” shall mean a written or graphic instrument issued prior to the execution of the Contract, which modify or interpret the Contract Documents, Drawings, and Specifications, by additions, deletions, clarifications, or corrections.

J. “Proposed Change Order” shall mean a written request for the Contractor’s Cost and Time Estimate covering an addition, deletion, or revision in the work, within the General Scope of the Contract.

K. “Change Order” shall mean a written order to the Contractor authorizing an addition, deletion, or revision in the work, within the General Scope of the Contract Documents, or authorizing an adjustment in the Contract Price or Contract Time.

L. “Field Order” shall mean a written order from the Engineer to the Contractor, directing an addition or revision in the work.

1.03 CHANGES IN CITY OF SACRAMENTO STANDARD SPECIFICATIONS

A. All reference in Section 8 of the Standard Specifications to actions by the “City Council” shall be amended to read action by the “City”.

B. Wherever reference is made to City Manager, Director of Utilities, Engineer, Finance Director, Inspector, or other specifically identified individuals, it shall include their designated representative.

C. Section 2-9 SUBCONTRACTORS, the statement reading “Contractor shall perform with his own organization and with the assistance of workers under his immediate superintendence, work of a value not less than fifty percent (50%) of the value of all work in the contract” shall be deleted.

1.04 EXCAVATIONS AND TRENCHING

A. Excavations or trenches crossing roadways, walks, or traffic ways shall be provided with suitable traffic bearing steel plate or wood planking temporary covers. Contractor shall verify location of all underground facilities prior to excavating and shall perform the work to avoid damage to existing underground facilities. Contractor shall repair at no additional cost to the City and to prior condition, any existing utility damaged due to work of this Contract.

B. If unusual amounts of bone, stone or artifacts are uncovered, work within 50 meters of the area shall cease immediately and a qualified archaeologist shall be consulted to develop, if necessary, mitigation measure to reduce any archaeologist impact to a less than significant effect before construction resumes in the area.

1.05 SPECIFICATIONS

A. The specifications are those bound and enumerated in the Table of Contents. The bidding Requirements, General Conditions, and Division 1 of the specifications apply to all work of this Contract.

1.06 HOURS OF WORK

A. Contractor shall perform the work of this contract on normal work days and within normal work hours, except after hours work, and work on Saturdays, Sundays, and holidays may be permitted if prior approval is obtained from the City. **Work on public streets shall be performed at night**. Overtime pay required to perform the work shall be included in the Contractor's lump sum price, and no additional compensation to the Contractor will be made for overtime work.

1.07 CONTRACTOR'S SET OF PLANS AND SPECIFICATIONS

A. City Furnished Plans and Specifications:

1. Upon award of Contract, the City will provide plans and specifications as follows:

a. Plans: 5 sets.

b. Specifications: 5 sets.

B. Additional Sets Furnished at Contractor's Cost:

1. Plans: Additional sets of plans will be furnished upon request, at Contractor's expense, at a price based upon City's cost. In the event partial sets are ordered, City will not be responsible for incomplete information.

2. Specifications: Additional sets of specifications will be furnished upon request, at Contractor's expense, at price based on City's cost.

1.08 INTERPRETATION OF DRAWINGS

A. The Contract Drawings consist of all of the plan sheets.

B. The data given herein, and on the drawings, are as exact as could be secured, but their absolute accuracy is not guaranteed. The Technical Specifications and drawings are for the assistance and guidance of the Contractor; exact locations, distance, elevation, etc., will be governed by the various structures, and Contractor shall use same with this understanding.

C. The Drawings are diagrammatic, but shall be followed as closely as existing conditions and existing structure will permit. Prior to submitting their sealed Proposal, the Contractor shall inspect the site and verify all measurements and conditions and shall be responsible for the correctness of same. No extra compensation will be allowed because of differences between work shown on the Drawings and measurements at the site.

D. Catalog numbers on the Drawings and in the Technical Specifications are from the best available information and are for guidance and assistance. The Contractor shall verify all catalog numbers and install only suitable materials.

1.09 REFERENCED PUBLICATIONS

A. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the test by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern.

1.10 QUESTIONS PRIOR TO BID OPENING

A. Prior to the opening of the sealed proposals, all questions concerning the Contract Documents shall be directed to Brett Ewart, (916) 808-1725, bewart@cityofsacramento.org

1.11 START OF WORK

A. The Contractor shall commence work on the day the NOTICE TO PROCEED is issued.

B. Any work performed by the Contractor in advance of receipt of the NOTICE TO PROCEED shall be considered as having been done at his own risk and as a volunteer unless NOTICE TO PROCEED is issued by the City.

PART 2 - PRODUCTS

2.01 CONSTRUCTION SCHEDULE

A. Contractor shall submit a Construction Schedule for the entire project in accordance with Section 01320, hereinafter**.** Construction Schedule shall be in the Critical Path Method (CPM) format. The proposed dates of commencement and completion of each of the various subdivisions of work required under these Special Provisions shall be shown. Include submittals, procurement, disposal, delivery, installation, testing, and final inspection. CPM shall be arranged in work weeks and shall show manpower. No Progress Payments will be made until the CPM schedule has been received by the Engineer.

PART 3 - EXECUTION

3.01 PRE-JOB CONFERENCE

A. The Contractor, after delivery of the Contract and at least three (3) days before beginning work, shall notify Renee Graves at (916) 808-1465 and arrange a pre-job conference. At this conference, the Contractor shall deliver appropriate submittals and a Construction Schedule as detailed below. The Contractor is responsible to provide plans and Special Provisions to subcontractors.

3.02 CONTRACTOR COMMUNICATIONS

A. All official communications between the Contractor and the City of Sacramento shall be made through the Engineer.

3.03 SUPERINTENDENT

A. Contractor shall assign a Superintendent to supervise all work and to represent the Contractor on site. The Superintendent shall cooperate with the City and shall provide assistance at all times for the inspection of the work: remove covers,

operate machinery, or perform any reasonable work which, in the opinion of the Engineer, is necessary to determine the quality or adequacy of the work. Superintendent shall also furnish material shipping labels and packing slips to the Engineer to verify that the material conforms with approved submittals and Specifications.

B. Superintendent shall lay out all work in advance of fabrication and shall be responsible for coordination of all related work.

C. Superintendent shall be responsible for scheduling utility and equipment shutdowns necessary to complete the work. Fifteen and three days prior to the proposed shutdown, the Superintendent shall obtain approval for the shutdown from the Engineer. The Engineer shall be given the following information.

1. Date and time of shutdown
2. Work to be accomplished during shutdown
3. Number of persons working during shutdown

D. Superintendent shall monitor and assure that:

1. Spillage resulting from hauling operations along, or across, any public traveled way shall be removed immediately by the Contractor at their expense.
2. Construction operations shall be conducted in such a manner as to cause as little inconvenience as possible to abutting property owners.
3. Water or dust palliative shall be applied, if ordered by the Engineer, for the alleviation or prevention of dust nuisance and shall be done at Contractor’s expense.
4. Contractor shall contact the Engineer for a visual inspection 48 hours prior to covering any underground conduit.
5. Full compensation for furnishing all labor, materials, tools, equipment, and incidentals and for doing all work involving maintenance of traffic and public safety shall be considered as included in the prices paid for various Contract items of work, and no additional compensation will be allowed, therefore.

3.04 PERMITS (NOT USED)

3.05 TRENCH SAFETY

A. Contractor's work shall conform to the provisions of Section 6705 of the Labor Code of the State of California.

B. Excavation for any trench five (5) feet, or more, in depth shall not begin until the City has received the Contractor’s detailed plan for worker protection from the hazards of caving ground during the excavation of such trench. Such plan shall be submitted at least five (5) days before the Contractor intends to begin excavation for the trench and shall show the details of the design of shoring, bracing, sloping, or other provisions to be made for worker protection during such excavation. No such plan shall allow the use of shoring, sloping, or a protective system less effective than that required by the Construction Safety Orders of the Division of Industrial Safety. If such plan varies from the shoring system

standards established by the Construction Safety Orders, the plan shall be prepared and signed by an engineer who is registered as a Civil or Structural Engineer in the State of California.

C. In addition, the Contractor shall obtain, pay for, and comply with all provisions of the permit required by Section 6500 of the California Occupational Safety and Health Act of 1973.

3.06 MAINTENANCE OF TRAFFIC, PUBLIC SAFETY AND CONVENIENCE

A. The Contractor's attention is directed to Sections 6-6, 6-7, 6-8, and 6-9 of the City Standard Specifications.

1. The Contractor shall be responsible for traffic control and public safety at all times. Vehicle and pedestrian traffic must be allowed to traverse all streets and alleys.

2. The Contractor shall furnish, install, and maintain temporary construction warning signs, flaggers, barricades, and other devices necessary to safeguard the general public and the work, and to provide for the safe and proper routing of all vehicular and pedestrian traffic within, and through, the limits of the project during the performance of the work.

3. Maintenance of traffic shall apply continuously, and shall not be limited to normal working hours. The use of flaggers, barricades, and construction warning signs shall comply with the current edition of *"Work Area and Traffic Control Handbook" (WATCH)*, available for review at the City of Sacramento, Public Works Agency, Traffic Engineering Division, located at 927 10th Street in Sacramento.

4. All lanes of traffic on adjacent street(s) shall remain open at all times during the course of construction, **except as described in Section 01550 Traffic Control, hereinafter.**

5. The Contractor shall be required to establish traffic scheduling and control measures acceptable to the Engineer prior to starting any work. The Contractor shall submit to the Engineer for review and approval a plan showing proposed traffic control measures and/or detours for vehicles and pedestrians affected by the construction work. This plan shall be submitted a minimum of ten (10) working days prior to the scheduled commencement of any work by the Contractor. The Contractor will not be allowed to begin work until an approved plan is on file with the Engineer. All advance warning and traffic delineation shall conform to the latest edition of "Work Area and Traffic Control Handbook", (WATCH). The approved traffic control plan shall be made available to the Engineer on site at all times.

3.07 PRE-CONSTRUCTION PHOTOGRAPHS

A. Pre-construction photographs shall be provided and shall conform to Section 11 of the City Standard Specifications.

3.08 EXISTING UTILITIES

A. Locations of both underground and overhead utilities are shown on the Drawings to the extent known. The actual location and elevation of the utilities may vary

from the locations shown. Unless the Drawings or Specifications identify that the Contractor is responsible for relocating utilities, utilities requiring relocation will be by the governing agency or their representatives. The Contractor shall coordinate relocations requested for the Contractor's convenience with the Engineer and the owner of the utility. The Contractor will cooperate with the relocation and/or protection of existing utilities.

B. The Contractor shall contact Underground Service Alert (USA) at 800-642-2444 at least 48 hours prior to the start of any excavation.

C. The Contractor shall contact Pete Millino of the City of Sacramento at (916) 808-5173 two (2) working days prior to performing excavation work within existing City facilities. The City will mark locations of existing City utilities within the facility.

3.09 MAINTAINING EXISTING DRAINAGE

A. The Contractor shall be responsible for maintaining existing drainage until new drainage improvements are complete and functioning. No additional compensation will be paid to the Contractor for maintenance of the existing facilities, and he should include the cost of this work in the items he deems appropriate.

3.10 COMPLETION AND FINAL INSPECTION

A. The work shall be so performed, that upon Contract completion, the project shall be ready for use. Included in the work shall be the furnishing of all labor, materials, tools, equipment, and incidentals necessary for completing the work, in accordance with the Contract Documents.

B. Submit written certification that the project, or a designated portion of the project, is substantially complete, and request, in writing, a final inspection. The Engineer will make an inspection within ten (10) days of receipt of request.

C. When the Engineer determines that the work is complete, the Engineer will prepare a list of deficiencies that need to be corrected before final acceptance, and issue a Notice-of-Completion with the deficiencies noted.

D. If the Engineer determines that the work is not complete, the Engineer will notify Contractor, in writing, stating reasons. After completing work, Contractor shall resubmit certification and request a new final inspection.

3.11 ACCEPTANCE OF THE WORK

A. After all deficiencies have been corrected, a Letter of Final Acceptance will be issued by the Engineer.

B. Acceptance may be given before correction of deficiencies that do not prevent operation and use of the project; however, Final Payment will be withheld until all deficiencies are corrected.

C. Until receipt of Letter of Final Acceptance, Contractor shall be responsible for all the work of the Contract.

D. Contractor must provide the following :

1. As-built drawings.

2. Operations and Maintenance Manual in electronic format. Files shall be in AutoCAD and Microsoft Office file format so as to be editable.

3. Submit the final instructional manuals in an Adobe PDF format as described in Section 01780.

3.12 WARRANTY

A. The term of the Contractor's warranty shall begin upon the date the job is accepted by the City.

END OF SECTION

SECTION 01110

SUMMARY OF WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Project: Shasta Park Water Facility.

B. The Project is located on a City-owned, five-acre parcel east of Bruceville Road. The facility will be located on the eastern portion of the five-acre parcel. The Project site is bound to the north by the cul-desac for Kastanis Way, to the east by several homes and the terminus of Cotton Lane, and bounded directly to the west by vacant property.

C. The work in this Contract consists of constructing the following:

1. A 2,800 gallon per minute potable water well excluding the below grade well casing which was previously constructed.
2. A groundwater treatment system with aeration to remove methane, oxidation, and filtration to remove manganese, and chlorine and fluoride addition.
3. A 4.0 million-gallon, wire-wrapped, prestressed concrete water storage reservoir.
4. Booster pump station with a firm rated capacity of 12 million gallons per day.
5. Control building with electrical control room, storage room, bathroom, and space for future chemical feed facilities.
6. All related site work including landscaping.

D. The Project property belongs to the City of Sacramento.

E. The work includes, but is not limited to the following:

1. Mobilization: Supply and transport of construction equipment, materials, supplies, appurtenances, etc., to perform the work.
2. Demobilization: Demobilization of construction plant and equipment, removal thereof and final cleanup and restoration of the site.
3. Project Construction: Construction of a water storage reservoir, pump station, CMU control building, yard piping, miscellaneous metal work, and site work.
4. Electrical and Plant Controls: Installation of lighting, electrical conduit and wiring, and controls.
5. Storage of Materials and Equipment Furnished: Provide the necessary equipment to unload, and temporarily store the materials and equipment, in accordance with the equipment manufacturer's requirements.

6. Miscellaneous: Construction of asphalt pavements, concrete sidewalks, driveways and slabs, CMU block wall fencing, wrought iron gates and fencing, cleaning of all debris and sediments.

7. Maintain Drainage: Maintaining, and furnishing if necessary, pumping facilities necessary to pump water from the site, the excavation, trenches or elsewhere.

8. Dewatering: Install, maintain, and operate groundwater wells for dewatering operations, if required.

9. Construct conduits and wiring necessary to implement the electrical equipment per Drawings and specifications.

10. Supply temporary facilities as necessary.

11. System Testing and Startup

12. All other work for a complete operable facility.

1.02 SECTIONS REFERENCED

A. The following Sections are referenced in this Section:

1. Section 01750 – Testing, Training, and Facility Start-Up

1.03 BID ITEMS

A. Item No. 1 – Mobilization (Note: The maximum amount bid for this item shall be six (6) percent or less of the total base bid)

1. This item shall consist of preparatory work and operations, including, but not limited to, those items necessary for bonding; insurance; movement of personnel, equipment, supplies, and incidentals to the project site; and for all other work and operations which must be performed or cost incurred prior to beginning work on the various contract items.

2. Payment and contract amount for Mobilization shall conform to Section 11 - Mobilization of the State of California, Caltrans Standard Specifications. The contract lump sum price paid for mobilization shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in mobilization.

B. Item No. 2 – Trench Sheeting, Shoring, and Bracing

1. This item shall consist of furnishing and installing all trench shoring, sheeting, and bracing associated with this project in accordance with the requirements of the City Standard Specifications.

2. Payment shall be at the contract lump sum price bid for trench sheeting, shoring, and bracing and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place.

C. Item No. 3 – Potable Water Well

1. This item shall include all contract work shown on the Drawings and these Special Provisions for the construction of the Potable Water Well except work included in other items.

2. Payment shall be at the contract lump sum price bid for construction of the Potable Water Well and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place as shown on the Drawings and these Special Provisions.

D. Item No. 4 – Groundwater Treatment System

1. This item shall include all contract work shown on the Drawings and these Special Provisions for the construction of the Groundwater Treatment System except work included in other items.

2. Payment shall be at the contract lump sum price bid for construction of the Groundwater Treatment System and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place as shown on the Drawings and these Special Provisions.

E. Item No. 5 – Concrete Water Storage Tank

1. This item shall include all contract work shown on the Drawings and these Special Provisions for the construction of the Concrete Water Storage Tank except work included in other items.

2. Payment shall be at the contract lump sum price bid for construction of the Concrete Water Storage Tank and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place as shown on the Drawings and these Special Provisions.

F. Item No. 5A – Concrete Water Storage Tank Specialty Prestressing (Performed by DN Tanks)

1. This item shall include structural design for the 4.0 MG AWWA D110 Type I prestressed concrete reservoir. Performance of structural observations at significant stages of the prestressed concrete tank work. Furnishing, stressing, and pressure grouting with epoxy vertical prestressing threadbars. Abrasive blasting exterior of concrete corewall. Furnishing and installing 3/8” diameter galvanized strand with fully automated strandwinder with continuous recording capabilities. Furnishing and installing shotcrete over wrapped strand using automated shotcrete process. Applying 7-day water cure on shotcrete. Furnishing seismic base restraint cables complete with neoprene sleeves

2. Payment shall be at the contract lump sum price bid for construction of the Specialty Prestressing of the Concrete Water Storage Tank and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place as shown on the Drawings and these Special Provisions.

G. Item No. 6 - Booster Pump Station

1. This item shall include all contract work shown on the Drawings and these Special Provisions for the construction of the Booster Pump Station except work included in other items.

2. Payment shall be at the contract lump sum price bid for construction of the Booster Pump Station and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place as shown on the Drawings and these Special Provisions.

H. Item No. 7 - CMU Control Building

1. This item shall include all contract work shown on the Drawings and these Special Provisions for the construction of the CMU Control Building except work included in other items.

2. Payment shall be at the contract lump sum price bid for construction of the CMU Control Building and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place as shown on the Drawings and these Special Provisions.

I. Item No. 8 - Electrical and Plant Controls

1. This item shall include all contract work shown on the Drawings and these Special Provisions for the construction of the Electrical and Plant Controls except work included in other items.

2. Payment shall be at the contract lump sum price bid for construction of the Electrical and Plant Controls and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place as shown on the Drawings and these Special Provisions.

J. Item No. 9 - Landscaping and Irrigation

1. This item shall consist of furnishing and installing all landscaping and irrigation as shown on the Drawings and these Special Provisions.

2. Payment shall be at the contract lump sum price bid for landscaping and irrigation and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place.

K. Item No. 10 - Wrought Iron Fence and Gates

1. This item shall consist of furnishing and installing wrought iron gates and fencing as shown on the Drawings and these Special Provisions.

2. Payment shall be at the contract lump sum ~~unit~~ price bid for wrought iron gates and fencing and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place

L. Item No. 11 - 24-Inch Diameter Water Transmission Main

1. This item shall consist of furnishing and installing a 24-inch diameter water transmission main as shown on the Drawings and these Special Provisions.

2. Payment shall be at the contract lump sum price bid and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place.

M. Item No. 12 - 6-Inch Diameter Sewer Main

1. This item shall consist of furnishing and installing a 6-inch diameter sewer main as shown on the Drawings and these Special Provisions.

2. Payment shall be at the contract lump sum price bid and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place.

N. Item No. 13 - All Other Work for Completion of the Shasta Park Water Facility

1. This item shall include all contract work shown on the Drawings and these Special Provisions for the construction of All Other Work for completion of the Shasta Park Water Facility including earthwork, yard piping, driveways, and paving, except work included in other items.

2. Payment shall be at the contract lump sum price bid for construction of All Other Work and shall include full compensation for furnishing all labor, materials, tools and equipment, and for performing all work necessary to complete this item in place.

1.04 CONTRACTOR'S BID STRUCTURE AND SCOPE OF THE WORK

A. Payment for this work is principally on a lump sum basis with an allowance made for unit price payment for additional work described herein.

B. The City will award the Contract to the lowest bidder based on the Total Bid amount.

C. The Scope of Work is defined in the Technical Specifications and Drawings, and is further summarized in this section.

D. The Contractor shall be reimbursed for all work in the Contract Documents, in accordance with the bid Proposal prepared by the Contractor.

1.05 MEASUREMENT AND PAYMENT

A. Full compensation for all furnishing all labor, materials, tools, equipment and incidentals and for doing all work involved in each item, shall be considered as included in the items of work as described in these Specifications, as shown on the Drawings and on the Sealed Proposal.

B. Quantities shown on the City's estimate are approximate. The City does not expressly or by implication agree that actual quantity of work will correspond therewith, but reserves the right to increase or decrease quantity of any item or portion of the work to omit portions of the work as may be deemed necessary or advisable by the City; also to make such alternatives or deviations, additions to, or omissions from the Drawings and Specifications as may be determined during progress of work to be necessary and advisable for proper completion.

C. The total bid amounts shall include, without limitation, all the work shown on the Drawings and as described elsewhere in these Specifications.

D. Progress Payments for the work shall be made as provided in Section 8 of the CSSS.

1.06 WORK NOT INCLUDED

A. The following work is NOT included in this Contract.

1. Any work shown, but marked “NIC” (Not In Contract) or Existing (E).

2. Any work otherwise designated to be done by others.

1.07 CONTRACTOR FURNISHED EQUIPMENT AND MATERIALS

A. All equipment and materials shall be furnished by the Contractor and shall be new and unused and shall conform to the requirements of these specifications. Where manufactured materials and equipment are specified, the same brand manufacturer for each class of material or equipment shall be used wherever possible.

B. The manufacturer’s warranty shall pass to the City and shall extend for a period of one year after project acceptance by the City.

1.08 POWER DISRUPTIONS

A. No long term electrical disruptions shall be permitted by the City during Contractor’s performance of the work without prior written approval of the City. The Contractor shall furnish, install, and operate all resources required for temporary power. All short term outages necessary for change over to temporary power, to make connection, or other activity shall be scheduled with the City at least three weeks in advance and will be subject to cancellation at any time by the City.

1.09 PROSECUTION AND PROGRESS OF THE WORK

A. The Contractor shall be responsible for planning, scheduling, and reporting the progress of the work so as to ensure timely completion of the work called for in the Contract. The Contractor shall prepare and submit a detailed plan as specified.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials are specified in these Technical Specifications, and in Sections 10 through 38 of the CSSS.

B. Submit and obtain approval for all Submittals before commencing fabrications or moving construction materials onto the project site.

C. All equipment, material, and supplies called for on the Drawings and Specifications shall be new.

D. All equipment shall be complete, ready for installation, and tested to the satisfaction of the Engineer at the time of acceptance of the work.

E. Unless specifically excluded in the Contractor’s Proposal, all incidental parts which are not shown on the Drawings, or specified herein, and which are necessary in order to have complete and operable facilities shall be furnished by the Contractor.

F. Manufactured articles, material, and equipment shall be applied, installed, connected, erected, adjusted, tested, used, cleaned, and conditioned as recommended by the manufacturer unless specified to the contrary. Copies of the manufacturer's installation instructions and procedures shall be submitted prior to the installation of manufacturer's articles, material, and equipment.

G. Materials and equipment shall be stored so as to insure the preservation of their quality and fitness for the work. Stores of equipment and materials shall be located to facilitate inspection. The Contractor shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until the completion of work and final acceptance by the City.

H. If any material does not conform with these specifications the Contractor shall, within three days after being notified by the Engineer, remove the materials from the project site or storage area.

2.02 MATERIAL PROVIDED BY THE CITY

A. Equipment that is not specifically identified as being provided by the City or others will be provided and installed by the Contractor.

2.03 CONTRACTOR ESTIMATES

A. Contractor shall provide a written estimate for all proposed changes to the work. The estimate shall be on tabular pre-printed estimating sheets. The estimate shall list all items of deletion and addition to the Contract. Each item shall have material, equipment, and labor units extended and summed. Contractor shall apply the allowable overhead and profit (CSSS 8-16) for a total estimated cost of the proposed change order.

PART 3 - EXECUTION

3.01 CONTRACTOR'S PLANT AND EQUIPMENT

A. Security: The Contractor shall, at all times, be responsible for the security of their plant and equipment. The City will not take any responsibility for missing or damaged equipment, tools, or personal belongings. The Contractor shall provide temporary security fencing and otherwise provide for the security of the existing facilities. These sites are particularly subject to vandalism. Materials left on-site are at the Contractor's risk and, if lost, at the Contractor's expense. The Contractor shall be responsible for the salvaged materials and equipment owned by the City and removed, or relocated, until the City has taken possession of such materials and equipment.

B. Workshop and Storage Facilities: The Contractor shall provide storage facilities for the protection from weather of materials and supplies, and shall keep the facilities clean and in proper order at all times. The project site has limited space for a storage yard. Additional property may need to be leased, at the Contractors expense, for storage facilities.

C. Parking Facilities: Parking areas at the project location are limited for the automobiles used by the Contractor's construction employees and Contractors own vehicles. A parking area shall be designated by the Contractor and approved by the Engineer.

3.02 CONTRACTOR'S UTILITIES

A. Electrical Power: The Contractor shall provide and make arrangements for temporary electric service for all required power and lighting required for the work under this Contract and shall maintain such service until the completion of the work.

B. Sanitary Facilities: The Contractor shall make arrangements for the maintenance of adequate toilet facilities at, or near, the work site and shall pay the costs thereof.

C. Temporary Heating: The Contractor shall provide temporary heating, covering, and enclosures, as necessary, to protect all work and material against damage by dampness and cold and to facilitate completion of the work. The Contractor shall supply all the fuel, power, equipment, and materials required for temporary heating.

3.03 LANDS PROVIDED BY CITY

A. The City will provide the Project property. The City will provided additional area for temporary storage of excavated materials as shown on the Drawings. Any additional land required for the construction of the work under this Contract, shall be the Contractor's responsibility.

3.04 FIELD ENGINEERING

A. The Contractor shall provide and pay for the following field engineering services required for this job:

1. The Contractor shall be responsible for setting all stakes or marks required for the completion of the work indicated on the Drawings, and in these Specifications.

2. Civil, structural, electrical, or other professional engineering services specified, or required, to execute the work.

3. Lost control points and property lines will be re-established at the expense of the Contractor.

B. The Contractor is responsible for determining the exact location of all existing utilities and for the protection of and repair of damage to them. Contact Underground Service Alert at 1-800-227-2600, 48 hours before work is to begin. Contractor shall also contact the City Department of Utilities Plant Services Division at (916) 808-5173 to identify City underground facilities on the facility site.

C. The Contractor shall be responsible for the protection of all existing survey monuments or markers during construction.

D. The Contractor shall be responsible for maintaining As-Built drawings for all underground work throughout the course of construction. Such drawing shall record the location and grade (City Datum) of all underground improvements constructed and shall be delivered to the construction inspector prior to, and, in consideration of the City's acceptance of work.

3.05 STORAGE OF MATERIALS AND EQUIPMENT

A. Materials and equipment shall be stored so as to insure the preservation of their quality and fitness for the work. Storage of equipment and materials shall be located so as to facilitate inspection. The Contractor shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment, including existing equipment, until completion and final acceptance of the work by the City.

3.06 SHIPPING AND PROTECTION OF EQUIPMENT

A. Definition: For the purpose of this paragraph, “equipment” means: all mechanical devices, all electrical devices, all items supplied by the City, all items removed by Contractor for later reinstallation, and all items with one or more moving parts.

B. Packing and Markings: All equipment shall be adequately and effectively protected against damage from moisture, dust, handling or other cause during transport from manufacturer's or supplier's premises to project site. Each item or package shall be clearly marked with a fitting or distinguishing mark, which shall be shown on the packing list. Stiffeners shall be used, where necessary, to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or sub-assembled units, where possible.

C. Identification of Equipment: Each item of equipment shall have firmly affixed to it a nameplate, label, or tag with its equipment number or other discrete identifying mark.

D. Storage of Equipment: Contractor shall provide storage for equipment for the entire interval between receiving and installation, and for the entire interval between being removed and reinstalled. Equipment shall be stored in an enclosed space affording protection from weather, dust, and mechanical damage and providing favorable temperature, humidity and ventilation conditions, as required, to ensure against equipment deterioration. For equipment that is not intended and prepared for outdoor installation, the storage container shall be heated above dew point temperature.

E. Protection of Equipment After Installation: After installation, all equipment shall be protected, as required. During construction, and until final acceptance by the City, all equipment that may be affected must be completely covered. All equipment shall be cleaned and vacuumed inside and outside prior to acceptance.

F. Delivery of Equipment: City personnel will not accept materials or equipment deliveries for the Contractor.

G. Security: Security of equipment stored by the Contractor is the Contractor’s responsibility. All losses or damage shall be replaced or repaired at the Contractor's expense.

3.07 TESTING

A. The City will field test earthwork and cast-in-place materials.

B. Notification: As an exception to requirements that may be stated elsewhere in the Contract, the Engineer shall be given two (2) working days notice prior to each

test. The Contractor shall perform all other testing, and submit written copies of all test results to the Engineer.

C. Failure to Meet Test: Any system material or workmanship which is found defective, on the basis of acceptable tests, shall be reported to the Engineer. Contractor shall replace the defective material or equipment and have test repeated until test proves satisfactory to the Engineer, without additional cost to the City.

D. Operational Testing: Operational testing consists of electrical testing specified in Section 01750: TESTING, TRAINING AND FACILITY START-UP.

E. Demonstration Testing: After all operational tests specified in Section 01750 are satisfactorily completed, the Contractor shall perform a demonstration test.

3.08 SAFETY

A. The Contractor shall execute and maintain their work so as to avoid injury or damage to any person or property. All work shall be done in conformance with the State of California, Division of Industrial Safety and OSHA Standards. Safety precautions, as applicable, shall include, but not be limited to, adequate fume protection; adequate illumination for underground and night operation; instruction in accident prevention for all employees; such machinery guards, walkways, scaffolds, ladders, bridges, and other safety devices, equipment and wearing apparel as are necessary or lawfully required to prevent accidents or injuries; and the proper inspection and maintenance of all safety measures. Contractor shall have emergency phone numbers and addresses posted on the jobsite.

3.09 PROTECTION OF EXISTING IMPROVEMENTS

A. The provisions of this Section shall supplement the provisions of CSSS Section 13.

B. Existing facilities, utilities, and property shall be protected from damage resulting from the Contractor's operations. All trees, shrubbery, fences, walls, asphalt, and other improvements, including existing pavements, sidewalks, street improvements, and underground utilities, and other improvements not shown on the Drawings shall be protected from damage by the Contractor throughout the construction period. Existing roadways and other improved surfaces shall be protected from damage by vehicles with tracks or lugs.

C. Any damage resulting from the Contractor's operations shall be repaired by the Contractor to the condition which existed prior to the damage, and to the satisfaction of the Engineer, at no additional cost to the City.

D. The Engineer may deduct from payments otherwise due the Contractor, the estimated cost of repairing any damage created by the Contractors operation, until such time that repairs are made by the Contractor to the Engineer’s satisfaction.

E. The Contractor shall be responsible for unlocking and locking the gates at the project site each work day in order to enter and exit the work area. The Contractor shall be responsible for the security of site and will be responsible for any damage to the reservoir and pump station, including replacing stolen materials, during the construction period.

3.10 MATERIAL NONCONFORMANCE

A. If any material does not conform with these Specifications, the Contractor shall, within three (3) days after being notified by the Engineer, remove the materials from the project site or storage area.

3.11 RESTORATION OF STRUCTURES AND SURFACES

A. Structures, Equipment and Pipework: The Contractor shall remove such existing structures, equipment, and pipework as may be necessary for the performance of the work, and shall rebuild, or replace, the items thus removed in as good a condition as found. Contractor shall repair any existing structures which may be damaged as a result of the work.

B. Curbs, Gutters, Driveways and Sidewalks: All curbs, gutters, driveways, sidewalks, and similar structures that are broken or damaged by the installation of the work shall be reconstructed by the Contractor. Reconstruction shall be of the same kind of materials with the same finish and in not less than the same dimensions as the original work. Repairs shall be made by removing and replacing the entire portions between joints or scores, and not merely refinishing any damaged part. All work shall match the appearance of the existing improvements, as nearly as possible.

C. Streets: All streets in which the surface is removed, broken, or damaged, or in which the ground has caved, or settled, due to work under this Contract, shall be completely resurfaced and brought to the original grade and crown section, unless otherwise indicated. Before resurfacing material is placed, edges of pavements shall be trimmed back far enough to provide clean, solid, vertical faces, and shall be free of any loose material. Roadways used by the Contractor for hauling materials, equipment, supplies, etc., shall be cleaned and repaired if the condition of the roadway is damaged, or otherwise affected, due to the Contractor's operations.

D. Cultivated Areas and Other Surface Improvements: All cultivated and natural areas, either agricultural or lawns, and other surface improvements which are damaged by actions of the Contractor shall be restored, including roadside drainage ditches, as nearly as possible, to their original condition.

END OF SECTION

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SECTION 01140

WORK SEQUENCE AND CONSTRAINTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General description of section.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

1. Section 01320 – Progress Schedules and Reports

1.03 CONTINUITY OF OPERATIONS

A. The Work under this project will interface with existing facilities.

B. Contractor shall coordinate the Work to minimize interference of the normal operation of the Owner's existing facilities through proper planning.

1.04 ACCESS

A. Contractor shall coordinate the work to avoid interference with vehicular access to the existing public facilities including Shasta Park Library and Shasta Park.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 WORK COORDINATION

A. Schedule and coordinate the overall Work and construction operations, including the work of subcontractors and the timely provision of products and supplies.

B. Perform Work in an orderly and logical sequence. Individual specification Sections may identify specific requirements that are related to Work sequence. These types of constraints are not repeated in this Section but shall be followed by the Contractor.

C. Contractor to coordinate the delivery of power with Sacramento Public Utility District.

3.02 CONNECTION TO EXISTING WATER SYSTEM

A. Contractor shall provide all materials and provide a temporary backflow device at selected water main connection points for Contractor use during flushing and testing. Contractor shall not operate any existing water valves. All water valve operation shall be conducted by the City.

B. Contractor shall make all excavations and furnish, install and maintain such shoring, bracing, and sheeting, and all materials necessary for the pipeline and these connections. Provide all materials including pipe, valves, mechanical couplings, and polyethylene sheets for a complete connection to existing pipe, and other related work as required for a complete installation, complete in place, ready for operation.

C. Shutdown shall occur between 10:00 P.M. and 6:00 A.M. during the off-peak water use season during the months of November through April. In preparation of the connection work, Contractor shall proceed according to the following schedule unless otherwise required by the City:

1. Locate, identify material, and general condition of existing water mains and other underground utilities by potholing or excavation prior to ordering connection pieces. Notify the Engineer of any apparent conflicts with the new work.

2. Complete all excavations and expose existing pipe in the area of the water main connections.

3. Provide all materials, equipment, temporary pumping equipment, and supplies approved by City and ready for installation.

4. Isolate the work area with barricades and other traffic control devices. Provide continuous traffic access around the work area at all times.

5. Install temporary backflow device (construction check).

6. After connections are completed and tested, backfill all trenches with aggregate base and provide temporary paving.

7. After improvements are completed and tested, restore full water system operation. Miscellaneous cleanup and other minor work may be delayed beyond restoration of water service. However, in no event shall work be delayed beyond the allowed work period.

D. Contractor shall notify the City of any shutdown 2 weeks, 1 week, and 24 hours in advance of any proposed shutdown. The Contractor shall schedule and coordinate the necessary shutdown of the existing water facilities with the City, the shutdown shall be held to a minimum and the Contractor shall have all materials required for the work at the job site prior to requesting the shutdown.

3.03 SEQUENCE AND CONSTRAINTS

A. Construct the Work in accordance with the sequencing requirements, construction constraints, work coordination and completion milestones defined in the following paragraphs and above. Include these requirements in the Construction Schedule required under Section 01320.

1. Contractor’s vertical turbine pump suction barrel submittal shall be completed and submitted to the Engineer within 30 working days from Notice to Proceed.

2. Contractor’s below grade steel pipe submittal shall be completed and submitted to the Engineer within 30 working days from Notice to Proceed.

END OF SECTION

SECTION 01150

FIELD ENGINEERING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The Contractor shall provide and pay for the following field engineering services required for this job:

1. Survey monuments as references for vertical and horizontal control points. The Contractor shall be responsible for setting all additional stakes or marks required for the completion of the work indicated on the drawings and in these specifications.

2. Civil, structural or other professional engineering services specified, or required to execute Contractor's construction methods.

B. Survey monuments have been described on the Drawings as references for vertical and horizontal control points.

1.02 QUALIFICATIONS OF SURVEYOR OR ENGINEER

A. Professional Engineer or Land Surveyor registered in the state of California.

1.03 SURVEY REFERENCE POINTS

A. Locate and protect control points prior to starting site work, and preserve all permanent reference points during construction.

1. Make no changes or relocations without prior written notice to Engineer.

2. Report to Engineer when any reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

3. Require surveyor to replace Project control points which may be lost or destroyed.

a. Establish replacements based on original survey control.

1.04 PROJECT SURVEY REQUIREMENTS

A. Establish lines and levels, locate and lay out, by instrumentation and similar appropriate means:

1. Site improvements.

a. Stakes for grading and fill placement.

b. Utility slopes and invert elevations.

2. Batter boards for structures.

3. Structure foundation and floor levels.

4. Controlling lines and levels required for mechanical and electrical trades.

B. From time to time, verify layouts by same methods.

1.05 RECORDS

A. Maintain a complete, accurate log of all control and survey work as it progresses.

1.06 SUBMITTALS

A. Submit name and address of registered land surveyor or professional engineer to Engineer.

B. On request of Engineer, submit documentation to verify accuracy of field engineering work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01310

PROJECT MEETINGS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Conduct and attend conferences and meetings for the purposes of addressing issues related to the work, reviewing and coordinating progress of the Work and other matters of common interest.

1.02 PRECONSTRUCTION CONFERENCE

A. Purpose of conference:

1. To designate responsible personnel and establish working understanding between parties
2. Status of insurance and bonds
3. Construction schedule and critical work sequences
4. Shop drawings and other submittals
5. Cost breakdown of major lump sum items
6. Field decisions and change orders
7. Maintaining record documents
8. Processing of submittals and applications for payment
9. Scope of work
10. Existing conditions
11. Equipment deliveries and priorities
12. All other essential matters pertaining to the satisfactory completion of the Project as required.

B. Attendance:

1. The contractor's representatives at this conference shall include all major superintendents for the work and may include major subcontractors. Other attendees shall be:
   a. Representatives of the City
   b. Utility company representatives, as appropriate
   c. Others as requested by the Contractor or City
2. The Engineer will preside at the pre-construction conference and will arrange for keeping and distributing the minutes to all persons in attendance. The Contractor shall plan on the conference taking no less than one hour.

C. Requirement:

1. Once a fully executed contract is received and prior to the commencement of work, the Engineer will schedule and chair a pre-construction conference to be held at the office of the Engineer. Prior to the pre-construction conference, the Engineer will develop the agenda for the meeting and meet with the project manager to review the agenda.

2. Notes of the conference will be maintained by the Engineer. After the meeting, the Engineer will transcribe the minutes of the meeting and discuss any issues that were raised.

3. The Contractor shall submit the following items to the City at the preconstruction conference:

   a. A preliminary schedule of shop drawings, samples and proposed substitutes ("or equal")

   b. A list of all permits the Contractor shall obtain indicating the agency required to grant the permit, the expected date of submittal for the permit, and the required date for receipt of the permit

   c. A 60-day plan of operation

   d. A project overview schedule

D. The Contractor is responsible to provide plans and special provisions to subcontractors.

1.03 PROGRESS MEETINGS

A. Purpose of Progress Meeting:

1. To review progress of subcontractors or other organizations that are not meeting scheduled progress, resolve conflicts, and coordinate and expedite execution of the Work. Additionally, to review the progress of the Work Progress Schedule, narrative report, Project Partial Payment Form, record documents, and additional items of current interest that are pertinent to execution of the Work.

B. Attendance:

1. The attendance of Contractor's superintendent and subcontractors who are actively involved in the work is required, as well as all others who are necessary to agenda. Additionally, the Engineer will invite the utility companies when the work affects their interests, and others necessary to agenda. The Engineer will preside at the meetings.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01320

PROGRESS SCHEDULES AND REPORTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Procedures for preparing and revising the construction schedule used for planning and managing construction activities.

1.02 METHOD

A. The Progress Schedule for this Project will also be referred to as the Critical Path Method (CPM) Schedule. A CPM network schedule is a graphical depiction of the Contractor's construction plan, showing the sequential activities necessary to complete the Work within the specified contract times and constraints.

B. The CPM network schedule for this Project shall depict events and tasks as activities, showing their interrelationships, and shall identify the progress required for each activity before subsequent activities can start.

1. Activities shall be logically presented in a network showing the activities' interrelationships chronologically.

2. Because each activity has an assigned duration, the completed network shall show the critical path of activities that must be completed on time to ensure timely project completion.

3. The earliest and latest start and finish times for each activity shall also be shown.

4. The CPM network shall be comprehensive and include all interdependencies and interactions required to perform the Work.

C. The construction schedules and accompanying reports outlined in this section are important to the Owner as they budget, plan and administer the Project.

D. The Owner, Construction Manager and/or Engineer will regularly analyze the most current progress schedule during construction to monitor progress status of the Project relative to the contract completion time(s).

E. The Schedule Updates and Weekly Schedules will be an agenda item at all project coordination meetings as project participants work together in prioritizing their respective tasks and action items to efficiently perform their duties.

F. The Time Impact Analyses are very important submittals to the Construction Manager and Owner as they evaluate activity durations and the relationships between activities before deciding on possible changes to the contract time and/or viable options to mitigate time impacts.

1.03 RESPONSIBLE SCHEDULING PERSON

A. Within five (5) days after the Notice to Award, the Contractor shall designate, in writing, an authorized representative in its firm who will be responsible for the preparation, revising, and updating of the Construction Schedule.

B. The Contractor's representative shall have direct project control and complete authority to act on behalf of the Contractor in fulfilling the construction scheduling requirements set forth herein, and such authority will not be interrupted throughout the duration of the Project.

C. The requirements for the Construction Schedule are included to assure adequate planning and execution of the Work and to assist the Construction Manager in appraising the reasonableness of the proposed schedule and evaluating progress of the Work.

1.04 SCHEDULING FORMAT AND SOFTWARE

A. Utilize critical path method (CPM) format.

B. Prepare computerized schedules utilizing Primavera Project Planner (P3) scheduling software version 3.1 or later versions, Primavera SureTrak scheduling software version 3.0 or later versions or Microsoft Project 2010 or later version, all of which must compatible with Windows.

C. Provide one licensed copy of the scheduling software program used to produce the Contractor’s Schedule to the Construction Manager, registered in the Construction Manager’s name. This licensed copy must be provided no later than five (5) days after the Notice to Proceed date.

1.05 PRELIMINARY PROGRESS SCHEDULE

A. Submit, within ten (10) calendar days after receipt of Notice to Proceed or Preconstruction Conference, whichever occurs first, a Preliminary Progress Schedule in the form of time scaled logic diagram and a bar chart which shows the Contractor’s intention to execute the Work within the specified contract times and constraints.

B. The Preliminary Progress Schedule shall cover the following project phases and activities:

1. Procurement and Submittals, including shop drawings and fabrication and delivery of key and long lead time procurement items.

2. The Contractor's submittal information shall show intended submittal dates and shall include, as a minimum, the maximum allowable review period as specified as a separate predecessor activity.

   a. The information shall provide sufficient durations for administration, fabrication and transportation to produce realistic delivery dates for the procurement items.

3. All activities planned for the first ninety (90) days in the execution of the Work.

4. The approach to scheduling the remaining activities or phases of the Work shall be represented by at least one summary activity for each major phase or activity. The total duration of the summary activities shall equal the Contract Time.

5. Approximate duration for each summary activity representing the Contractor's best estimate for the work the summary activity represents.

6. Weather days.

1.06 CONSTRUCTION BASELINE SCHEDULE

A. Baseline Schedule Preparation

1. Submit the schedule based on the Critical Path Method (CPM).
   a. The schedule shall indicate preceding activity relationships and/or restraints where applicable and a controlling path shall be indicated.
   b. The schedule shall produce a clear, legible, and accurate calendar based, time scaled and graphical network diagram.
2. Include for each activity, the description, activity number, estimated duration in work days, total float and all activity relationship lines.
3. Illustrate order and interdependence of activities and sequence in which the Work is planned to be accomplished.
4. Reference schedule in working days with beginning of Contract Time as Day “1”.
5. The Baseline Schedule and all updates or revisions shall show completion of the Project within the required contract completion times and constraints on the Work. Failure to do so may result in the Owner terminating for cause.
6. Acceptance of the Contractor’s Base CPM Schedule, monthly updates or revised schedule, when based on less time than the maximum time allowed for milestone(s) or Contract completion does not serve to change any Contract duration, nor serve as a waiver of the Contractor’s nor the Owner’s right to utilize the full amount of time specified in the Contract, unless so modified in a Contract Change Order.
7. Clearly show the sequence of construction operations and specifically list:
   a. The start and completion dates of all work items.
   b. The dates of submittals, procurement, delivery, installation and completion of each item of equipment and material requirement.
   c. Progress milestone events or other significant stages of completion, as defined in the Contract Documents.
   d. The lead time required for testing, inspection and other procedures required prior to acceptance of the Work.
   e. The activities shall be grouped by responsibility, phases, milestones, work area, trade and subcontractor to provide logical summary activities.
   f. All activities of the Owner and the Construction Manager that affect progress of the Work along with required contract dates for completion of all activities of the Owner and Construction Manager.
   g. All activities of utilities, regulatory agencies and permitting agencies.
   h. All system shut-down, system tie-in and system bypass activities.

8. Work Activities

   a. All Work activities should be of sufficient detail to ensure adequate planning and execution of the Work and such that schedules provide an appropriate basis for monitoring and evaluating the progress of the Work.

   b. A work activity is defined as a single task that requires time and resources (manpower, equipment and/or material) to complete in a continuous operation, excluding submittal activities, review/acceptance activities, and fabrication/procurement activities.

   c. Durations for on-site work activities shall be in working days and shall not exceed ten (10) workdays. This limitation may be waived, upon approval of the Construction Manager, for repetitious activities of longer durations for which progress can be easily monitored.

   d. Passive on-site activities such as curing and testing periods can be in calendar days if desired by Contractor. All such passive on-site activities shall be included in the Contractor's schedule and durations should be as specified in the Contract Documents.

9. Delineate the specified Contract duration and identify the planned completion of the Work as the final milestone. The time period between these two dates, if any, shall be considered contract float.

10. "Total Float" or "Float"

   a. Defined as the difference between the early finish and late finish dates for an activity.

   b. Float in any activity, milestone completion date or Contract completion date shall be considered a resource available to both the Owner and the Contractor.

   c. Neither the Owner nor the Contractor has ownership of the float. Float is for the benefit of the Project.

   d. Acceptance of the Contractor's Baseline Schedule, monthly updates or revised schedule, when based on less time than the maximum time allowed for milestone(s) or Contract completion does not serve to change any Contract duration, nor serve as a waiver of the Contractor's nor the Owner's right to utilize the full amount of time specified in the Contract, unless so modified in a Contract Change Order.

   e. Float shall not be an activity unless approved by the Construction Manager.

11. Critical Path

   a. Indicate the critical path for the Project.

   b. The schedule shall not show more than 10 percent of the total number of activities as critical; and not show more than 20 percent of the activities with floats or 10 working days or less.

12. Failure to include an activity required for execution of the Work does not excuse the Contractor from completing the Work and portions thereof within the specified times and at prices specified in the Agreement.

13. Failure of the Contractor to include required schedule constraints, sequences or milestones in schedule shall not relieve Contractor of its obligation to conform to requirements of Contract. Acceptance of schedule shall not waive Contract requirements of Contract. Acceptance of

B. Baseline Schedule Submittal

1. Submit an acceptable Critical Path Method (CPM) Baseline Schedule to the Construction Manager within thirty-five (35) calendar days of Notice to Proceed for all Work of the Project.

2. Subsequent revisions to the Baseline Schedule shall be submitted as set forth herein. No more than two (2) progress payments will be made prior to submission and acceptance of the CPM Baseline Schedule by the Construction Manager.

3. Produce and provide four (4) complete sets each of time-scaled network logic diagrams and bar charts in color on 11-inch by 18-inch sheets and one electronic copy on a CD with data in the Contractor's chosen scheduling software format.

   a. The network logic diagram shall be clear and legible.

   b. Critical activities shall be indicated in red color.

4. Provide four (4) sets of tabular reports listing all activities sorted numerically identifying duration, early start, late start, early finish, late finish, total float and all predecessor/successor information.

C. Baseline Schedule Review and Acceptance

1. The Construction Manager will issue written comments following completion of Baseline Schedule review within 21 calendar days after receipt.

   a. Should it be required, the Contractor shall revised and resubmit Baseline Schedule in accordance with Construction Manager's comments within seven (7) calendar days after receipt of such comments.

   b. To facilitate the production of an acceptable Baseline Schedule submittal, the Contractor may request a meeting with the Construction Manager to discuss the first submittal review comments.

2. Acceptance of schedule shall not waive Contract requirements of Contract. In the event of conflict between accepted schedule and Contract requirements, the terms of the Contract shall govern at all times, unless requirements are waived in writing by the Owner.

1.07 WEATHER CONDITIONS

A. Seasonal weather conditions shall be considered in the planning and scheduling of work activity durations influenced by high or low ambient temperatures or precipitation to ensure the completion of the Work within the Contract Time.

B. No time extensions will be granted for the Contractor's failure to take into account such weather conditions for the location of the Work and for the period of time in which the Work is to be accomplished.

C. When weather days are experienced, and are approved as such by the Construction Manager, the Contractor shall either:

1. Increase the duration of the current critical activity(ies) by the number of weather days experienced, or

2. Add a critical activity to the schedule to reflect the occurrence of the weather day(s).

D. The duration of the weather day allowance activity shall be reduced as weather days are experienced and included in the schedule.

E. Any remaining weather days in the weather day allowance activity at the completion of the Project shall be considered as float and shall not be for the exclusive use or benefit of either the Owner or Contractor.

1.08 CONSTRUCTION SCHEDULE UPDATES

A. Submittal Period

1. Update the Baseline Schedule on a monthly basis (or at shorter intervals if deemed necessary by Construction Manager to identify corrections necessary, such as work activities fifteen (15) days or more behind schedule) for the purpose of recording and monitoring the progress of the Work.

2. The Updated Baseline Schedule shall incorporate changes mutually agreed upon by Contractor and Construction Manager during preceding periodic reviews and changes resulting from approved Change Orders and Field Orders.

3. The Contractor shall produce and provide four (4) complete sets each of time-scaled network logic diagrams and bar charts in color on 11-inch by 17-inch sheets and one electronic copy on a CD with data in the Contractor’s chosen scheduling software format.

   a. The network diagram shall be clear and legible.

   b. Critical activities shall be indicated in red color.

   c. Progress bars shall be conspicuously identified by color other than red, black or white.

4. The Owner will not make monthly progress payments to the Contractor until the Construction Manager has received and accepted all schedule updates and reports as herein specified.

5. The Contractor should submit schedule updates and reports to Construction Manager at least five (5) days before Contractor’s submission of its request for progress payment for same monthly period.

B. All Monthly Updates shall include as a minimum:

1. Narrative and Tabular Report

a. The report shall show the activities or portions of activities completed during the reporting period.

b. The report shall state the percentage of the work actually completed and scheduled, the remaining duration, and the progress along the critical path in terms of days ahead or behind the allowable dates as of the report date.

c. Any changes made by the Contractor to the CPM schedule, including activities deleted, activities added, activity numbers, durations, constraints and activity descriptions, shall be listed in a detailed report which describes the reason for each.

2. Activity Numbers and Descriptions

a. New activity numbers and descriptions may be added where required to further define the Work and as approved by the Construction Manager.

b. Activities may be deleted if the applicable work has not been performed and is deleted from the Work and as approved by the Construction Manager.

C. Schedule Review

1. Once each month, on a date mutually agreed upon, but no later than ten (10) days after the submittal of the monthly update specified herein, a jobsite meeting will be held to review the CPM Schedule, job progress and the monthly update, or the Construction Manager will provide written comments on the monthly update.

D. Schedule Revisions

1. The conditions under which the Construction Manager will require revisions of the CPM Schedule include the following:

a. When delay in completion of any work item or sequence of work items results in an estimated extension of any required Contract Completion Event by either twenty (20) working days or by five percent (5%) of the remaining duration of time to complete the Contract Completion Event, whichever is less.

b. When delays in submittals or deliveries make replanning or rescheduling of the Work necessary.

c. When the schedule does not represent actual prosecution and progress of the Work.

d. When any change to the sequence of activities, the completion date for major portions of the Work, or changes occur which affect the critical path.

e. When Contract modification necessitates schedule revision.

1.09 TIME IMPACT ANALYSES

A. When change orders are initiated, delays are experienced, or the Contractor desires to revise the schedule logic, the Contractor shall submit to the

Construction Manager a written Time Impact Analysis illustrating the influence of each change, delay, or Contractor request on the current contract schedule completion date.

B. Activity time delays will not automatically mean that an extension of Contract Time is warranted or due the Contractor.

C. It is possible that an excusable delay or contract modification will not affect existing critical activities or cause noncritical activities to become critical, i.e., a delay or modification may result in only absorbing a part of the available total float that may exist within an activity chain of the network, thereby not causing any effect on the Contract completion date or time.

D. The Contractor acknowledges and agrees that mitigation for delays due to changes, differing site conditions, suspension of the Work and other causes will require revision of preferential sequences of the Work.

1. Accordingly, to mitigate delays, the activities shall be resequenced prior to the Contractor proposing an updated schedule which supports a delay to the Project as a whole.

2. When a delay to the Project as a whole can be avoided by revising preferential sequencing, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension but is not entitled to compensation for extended overhead for this extended duration.

E. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond a milestone or the Contract completion date will not be the basis for an adjustment to the Contract Time.

F. Extensions of time can be granted for a delayed or impacted activity only for the duration of the time adjustment which exceeds the total float for the schedule path wherein the activity is located. The adjustment is only applicable during the time the delay occurred or when the change is ordered.

G. CPM Schedule - Analysis

1. Each Time Impact Analysis shall include a fragmentary network analysis demonstrating how the Contractor proposes to incorporate the change order, delay, or Contractor request into the CPM Schedule.

2. The analysis shall demonstrate the time impact based on the date of occurrence of the change, delay or revision; the status of construction at that point in time; and the event time computation of all affected activities.

3. The event times used in the analysis shall be those included in the latest updated copy of the CPM Schedule or as adjusted by mutual agreement between the Construction Manager and Contractor.

H. Time Impact Submittal and Review

1. Time Impact Analysis shall be submitted in triplicate and within fifteen (15) days after a delay occurs or with the Contractor's cost proposal in response to a notice of change from the Construction Manager.

2. In cases where the Contractor does not submit a Time Impact Analysis for a specific change order, delay, or other Contractor requested time extension within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.

3. Approval or rejection of Time Impact Analyses by the Construction Manager and the Owner will be made within fifteen (15) calendar days after receipt of the Time Impact Analysis unless subsequent meetings and negotiations are necessary.

4. Upon approval, a copy of the Time Impact Analysis signed by the Construction Manager and Owner will be returned to the Contractor.

5. Upon mutual agreement by both parties, schedule revisions illustrating the influence of change orders, delays, and/or Contractor requests will be incorporated into the next schedule update.

1.10 WEEKLY ACTIVITIES PLAN

A. On the last working day of every week the Contractor shall submit to the Construction Manager the Contractor's progress schedule showing the activities completed during the previous week and the Contractor's schedule of activities for the following three (3) weeks.

B. The Weekly Schedule may be a CPM schedule or a bar chart but shall utilize the logic and conform to the status of the current progress schedule. In the event that the Weekly Schedule no longer conforms to the current schedule Contractor may be required to revise the schedule in accordance with Article, "Revisions to Schedule".

C. The activity designations and activity numbers used in the Weekly Schedule shall be consistent with those used in the Baseline Schedule and the monthly Schedule Updates.

D. The format of the Weekly Schedule shall be as agreed upon between the Contractor and the Construction Manager.

1.11 CONTRACTOR’S DAILY REPORTS

A. Maintain daily job reports recording all significant activity on the Project, including number of workers on site, active construction equipment used, notable deliveries, work activities, delays, interruptions or any problems encountered.

B. Record this information and submit it to the Construction Manager no later than the following morning for the previous work day.

C. If there is no work performed on any given day, note the reasons for no work and submit a daily report to the Construction Manager on those days also.

D. Failure to stay current with daily reporting will be just cause for the Owner not processing a progress payment until reports are submitted.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01330

SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous work-related submittals. Submittals shall also include, but not be limited to, mechanical equipment and systems, materials, reinforcing steel, fabricated items, piping and valves.

B. Furnish drawings, specifications, descriptive data, certificates, samples, tests, methods, schedules, manufacturer's installation instructions and other information to fully demonstrate that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the Contract Documents.

1.02 STANDARD COMPLIANCE

A. When materials or equipment must conform to the standards of organizations such as, but not limited to, the American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA) and Underwriter's Laboratories (UL) documents showing, or proving, conformance shall be submitted.

B. If an organization uses a label or listing to indicate compliance with a particular standard, the label or listing will be acceptable evidence, unless otherwise specified in the individual Sections. In lieu of the label or listing, the Contractor shall submit a certificate from an independent testing organization, which is competent to perform acceptable tests, and is approved by the City. The certificate shall state that the item has been tested in accordance with the specified organization's standard. For materials and equipment whose compliance with organizational standards or specifications is not regulated by an organization using its own listing or label as proof of compliance, a certificate of compliance from the manufacturer shall be submitted for approval. The certificate shall identify the manufacturer, the product, and the referenced standard and shall state that the manufacturer certifies that the product conforms to all requirements of the project Specification and of the referenced standards listed.

1.03 REVIEW OF CONTRACTOR'S INFORMATION

A. When review and checking for acceptance is required of any drawing, or information regarding materials and equipment, the Contractor shall prepare or secure, and submit for review, six (6) copies. The Engineer, after taking appropriate action, will return two (2) marked copies to the Contractor.

1. Within a reasonable time after receipt of said submittal copies, the Engineer will return the marked copies indicating one of the following four (4) actions:

a. If review and checking indicates no exceptions, copies will be returned marked “NO EXCEPTIONS TAKEN” and work may begin immediately on incorporating the material and equipment covered by the submittal into the work.

b. If review and checking indicates limited corrections are required, copies will be returned marked “MAKE CORRECTIONS NOTED”. Work may begin immediately on incorporating into the work the material and equipment covered by the corrected submittal.

c. If review and checking indicates insufficient, or incorrect data, has been submitted, copies will be returned marked “REVISE AND RESUBMIT”. No work may begin on incorporating the material and equipment covered by this submittal into the work until the submittal is revised, resubmitted, and returned marked either “NO EXCEPTIONS TAKEN” or “MAKE CORRECTIONS NOTED”.

d. If review and checking indicates the material and equipment submittal is unacceptable, copies will be returned marked “REJECTED”. No work may begin on incorporating the material and equipment covered by this submittal into the work until a new submittal is made and returned marked either “NO EXCEPTIONS TAKEN” or “MAKE CORRECTIONS NOTED”.

B. Approval of the submittal by the Engineer shall not relieve the Contractor from responsibility for any errors or omissions in such submittals nor from responsibility for complying with the requirements of this Contract.

C. If Shop Drawings show variations from Contract requirements, Contractor shall describe such variations in writing, separate from the drawings, at time of submission. All such variations must be approved by the Engineer.

PART 2 - PRODUCTS

2.01 MANUFACTURER'S DATA

A. Submittals for each manufactured item shall be comprised of manufacturer's descriptive literature, drawings, diagrams, performance and characteristic curves, and catalog cuts. Manufacturer's name, trade name, model or catalog number, nameplate data, size, layout dimensions, capacity, project specification references, and any other additional information necessary to establish contract compliance shall be clearly indicated for each item submitted. Contractor shall identify items submitted for approval using an arrow or yellow high-lighter. All submittals that fail to properly identify items will be returned to the Contractor.

2.02 SHOP DRAWINGS

A. Shop Drawings shall show types, sizes, accessories, elevations, floor plans, sectional views, installation details, elementary diagrams, and wiring diagrams. Wiring diagrams shall identify circuit terminals and shall indicate the internal wiring for each item of equipment. Drawings shall also indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If any equipment is disapproved, the drawings shall be revised to show acceptable equipment and be resubmitted.

B. Contractor shall provide a hard copy and electronic copy of all shop drawings. The electronic copies shall be in Adobe format (Portable Document Format) and shall be provided on a CD. Contractor shall use latest version of Adobe.

2.03 OPERATION AND MAINTENANCE MANUAL

A. Submit an operation and maintenance manual covering the stipulated systems and equipment. Six (6) approved copies of the manual, bound in Avery D - Ring binder model number AVY79-799 or approved equal, shall be furnished to the City. One of the six copies of the operation and maintenance manual shall contain original documentation/manuals and not photocopies. Each binder shall be no more than 75% full. Prior to system and equipment tests, one complete, bound copy of the manual shall be submitted for approval. Six (6) approved copies of the manual each for this project, with all applicable test forms completed, shall be furnished to the City before completion of the Contract. The following identification shall be inscribed on the cover and spine of the binders:

Operation and Maintenance Manual - Electrical Controls

Project: Shasta Park Water Facilities

Contractor:

Contract No.:

Date:

1. The Contractor shall also provide the City with an electronic copy of each O&M manual. The electronic copies of drawings shall be in Adobe format (Portable Document Format), the text in WORD 2010 and shall be provided on a CD. Contractor shall use latest version of Adobe.

B. Provide a table of contents and tab sheets to identify discrete subjects. Instruction sheets shall be legible and easily understood with large sheets and drawings folded in. Use manufacturer's original pre-printed instructions when available, do not Xerox these pre-printed instructions. Cross out all material which does not apply to the equipment furnished on this job.

C. The operating and maintenance instruction shall include, as a minimum, the following data for each item of mechanical and electrical equipment:

1. Name and location of the manufacturer, the manufacturer's local representative, the nearest supplier and spare parts warehouse.
2. Approved submittals applicable to operation and maintenance.
3. Recommended installation, adjustment, start-up, calibration, and troubleshooting procedures.
4. A control sequence describing start-up, operation, and shutdown.
5. Detailed description of the function of each principal component of the systems.
6. Recommended lubrication and an estimate of yearly quantity needed.
7. Recommended step-by-step procedures for all modes of operation.
8. Complete internal and connection wiring diagrams.

9. Complete printed circuit board schematic and assembly drawings.

10. Recommended preventive maintenance procedures and schedule.

11. Complete parts lists, by generic title and identification number, with exploded views of each assembly.

12. Recommended spare parts.

13. Disassembly, overhaul, and reassembly instructions.

14. All completed test forms.

15. Provide ISA (International Society for Measurement and Control) S-20 forms for all instrumentation devices.

D. Contractor is not required to provide manuals for the equipment supplied by the City. However, any manuals provided to the Contractor by the City shall be returned in a condition acceptable to the Engineer, or replaced at no cost to the City.

2.04 PROJECT RECORD DRAWINGS

A. The Contractor shall maintain a neatly and accurately marked set of record drawings showing the final locations and layout of all mechanical, electrical, and instrumentation equipment; piping and conduit; structures; and other facilities. Drawings shall be kept current weekly, with all work instructions and change orders; mechanical, electrical, and instrumentation equipment accommodations; and construction adjustment. Drawings shall be subject to the inspection of the Engineer at all times, and progress payments, or portions thereof, may be withheld if drawings are not accurate and current. Prior to acceptance of the work, the Contractor shall deliver to the Engineer two (2) sets of neatly marked record drawings, accurately showing all the information required above.

PART 3 - EXECUTION

3.01 SUBMITTAL PROCEDURE

A. At least thirty (30) days prior to the Contractors need for approval, Contractor shall forward to the Engineer all submittals required by the individual Sections of the Specifications. The Engineer may require that the Contractor submit a legible reproducible mylar for the City's use in lieu of multiple prints of a single drawing.

B. Identify all submittals by submittal number on letter of transmittal. Specification number shall be identified on the letter of transmittal. Submittals shall be numbered consecutively and resubmittals shall have a letter suffix. For example:

1. 1st submittal: 2

2. 1st resubmittal: 2A

3. 2nd resubmittal: 2B, etc.

3.02 CONTRACTOR SUBMITTALS

A. Items to be submitted are specified in individual Sections of these Specifications. Submittals for each Section shall be bound together in one book. Book shall have numbered tab dividers for each item.

B. Submittals that are related to, or affect, each other shall be forwarded simultaneously as a package to facilitate coordinated review. Uncoordinated submittals will be rejected. Do not combine unrelated materials in the same submittal.

C. Submittals shall be arranged in same order as they appear in the Specification Section. Items shall be highlighted and clearly marked with the same identification number as indicated on the drawings.

D. The Contractor shall include submittal time appropriate within each item of work on the Construction Schedule.

END OF SECTION

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SECTION 01410

QUALITY CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work Included

1. Cooperate with the Engineer's selected testing agency and all others responsible for testing and inspecting the work as described herein.

2. Provide such other testing and inspecting as are specified to be furnished by the Contractor in this section and/or elsewhere in the contract documents.

B. Related Work

1. Requirements for testing may be described in various sections of these specifications and applicable codes.

2. Where no testing requirements are described but the Engineer decides that testing is required, the Engineer may require such testing to be performed under current pertinent standards for testing. Payment for such testing will be made as described in this section.

C. Work Not Included

1. Selection of testing laboratory: The City will select a prequalified independent testing laboratory.

2. Payment for specified initial testing: The City will only pay for initial services of the testing laboratory for items described in 1.02 TESTING DESCRIPTION, paragraph A.1, herein.

1.02 TESTING DESCRIPTION

A. Material Strength

1. The City will pay for initial testing services for concrete strength and slump, soil compaction and grout strength.

2. When initial tests indicate non-compliance with the Contract Documents, the costs of any additional tests required for determining compliance will be deducted by the City from the Contract Sum.

B. Operational Testing

1. All operational tests shall be paid for by the Contractor.

C. Code Compliance Testing

1. Inspections and tests not identified in this section, that are required by codes or ordinances, or by a plan approval authority, and which are made by a legally constituted authority, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.

D. Contractor's Convenience Testing

1. Inspecting and testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

2. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

E. The City will provide initial testing for trench/structure backfill and embankment compaction.

1.03 REFERENCES

A. ANSI/ASTM D3740 – Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

B. ANSI/ASTM E329 – Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

1.04 LABORATORY REPORTS

A. After each inspection and test, promptly submit three copies of laboratory report to the Engineer. Include: Date issued, Project title and number, name of inspector, date and time of sampling or inspection, identification of product and Specifications section, location in the Project, type of inspection or test, date of test, results of tests, and conformance with Contract Documents. When requested by Engineer, provide interpretation of test results.

1.05 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Laboratory may not approve or accept any portion of the Work.

C. Laboratory may not assume any duties of Contractor.

D. Laboratory has no authority to stop Work.

1.06 CONTRACTOR RESPONSIBILITIES

A. Deliver to laboratory at designated location adequate samples of materials proposed to be used which required testing, together with proposed mix designs.

B. Cooperate with laboratory personnel, and provide access to Work and to manufacturer's facilities.

C. Provide incidental labor and facilities to provide access to work to be tested, to obtain and handle samples at the site or at source of products to be tested, to facilitate tests and inspections, and for storage and curing of test samples.

D. Notify laboratory 24 hours prior to expected time for operations requiring inspection and testing services.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 COOPERATION WITH TESTING LABORATORY

A. Representatives of the testing laboratory shall have access to the work at all times and at all locations where the work is in progress. Provide facilities for such access to enable the laboratory to perform its functions properly.

3.02 TAKING SPECIMENS

A. All specimens and samples for testing, unless otherwise provided in the Contract Documents, shall be taken by the testing personnel. All sampling equipment and personnel will be provided by the testing laboratory. All deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

3.03 SCHEDULES FOR TESTING

A. Establishing Schedule:

1. By advance discussion with the testing laboratory selected by the City, determine the time required for the laboratory to perform its tests and to issue each of its findings.

2. Provide all required time within the construction schedule.

B. Revising Schedule: When changes of construction schedule are necessary during construction, coordinate all such changes with the testing laboratory as required.

C. Adherence to Schedule: When the testing laboratory is ready to test according to the established schedule, and is prevented from testing or taking specimens due to incompleteness of the work, all extra charges for testing attributable to the delay may be back-charged to the Contractor and shall not be borne by the City.

3.04 TESTING PROCEDURES

A. Notification: As an exception to requirements that may be stated elsewhere in the contract, the Engineer shall be given 3 working days notice prior to each test. The Contractor shall provide all test equipment and personnel and submit written copies of all test results.

B. Failure to Meet Test: Any system material or workmanship which is found defective on the basis of acceptable tests shall be reported to the Engineer. Contractor shall replace the defective material or equipment and have test repeated until test proves satisfactory to the Engineer without additional cost to the City.

C. Operational Testing: After all pre-operational tests are satisfactorily complete, Contractor shall perform an operational test. All mechanical and electrical equipment shall be tested by the Contractor to the satisfaction of the Engineer before any facility is put into operation. Tests shall be made to determine whether the equipment has been properly assembled, aligned, adjusted and connected. Any changes, adjustments or replacements required to make the equipment operate as specified shall be carried out by the Contractor as part of the work.

END OF SECTION

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SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for:

1. Heat and Ventilation
2. Telephone Service
3. Water
4. Sanitary Facilities
5. Construction Aids
6. Enclosures
7. Barriers
8. Cleaning During Construction
9. Project Identification
10. Security
11. Safety
12. Noise Control

1.02 HEAT AND VENTILATION

A. Provide as required to maintain specified conditions for construction operations, to protect materials and finishes from damage due to temperature or humidity.

B. Prior to operation of permanent facilities for temporary purposes, verify that installation is approved for operation, and that filters are in place. Provide and pay for operation, maintenance, and utilities.

C. Provide ventilation of enclosed areas to cure materials, to disperse humidity, and to prevent accumulations of dust, fumes, vapors, or gases.

1.03 TELEPHONE SERVICE

A. Cellular telephone service is acceptable.

1.04 WATER

A. Make provisions for water necessary for construction operations and for testing. The Contractor shall be responsible for all associated costs. Make the necessary connections to the public water supply and install all conveyance piping and truck filling facilities that are required to transport water for the work at the sole expense of the Contractor.

B. At the sole expense of the Contractor temporarily install valves, flow meters, air gaps, backflow preventers and other appurtenances required by the City to

maintain the integrity of the existing water system. Remove temporary water facilities when no longer needed.

1.05 POWER

A. The Contractor shall arrange for all temporary power for all construction operations. Contractor shall be responsible for all connections to activate temporary power.

1.06 SANITARY FACILITIES

A. Sanitary Facilities: The Contractor shall make arrangements for the maintenance of adequate toilet facilities at or near the work site and shall pay the costs thereof.

1.07 CONSTRUCTION AIDS

A. Provide and operate drainage and pumping equipment as required to maintain excavations and site free of standing water.

1.08 ENCLOSURES

A. Provide temporary weather-tight closures of openings in exterior surfaces to provide acceptable working conditions and protection for materials, to allow for temporary heating, and to prevent entry of unauthorized persons. Provide doors with locks.

1.09 BARRIERS

A. Provide as required to prevent public entry to construction areas and to protect existing facilities and adjacent properties from damage from construction operations.

B. Provide temporary chain-link fence around construction site; equip vehicular and pedestrian gates with locks.

1.10 CLEANING DURING CONSTRUCTION

A. Control accumulation of waste materials and rubbish; periodically dispose of off-site in a location approved by the Engineer.

B. Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants during finishing operations.

1.11 REMOVAL

A. Remove temporary materials, equipment, services, and construction prior to Substantial Completion inspection.

B. Clean and repair damage caused by installation or use of temporary facilities. Remove underground installations to a depth of 2 feet, grade site as indicated. Restore existing facilities used during construction to specified, or to original, condition.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 CONTRACTOR'S PLANT AND EQUIPMENT

A. Security: The Contractor shall at all times be responsible for the security of his plant and equipment. The City will not take any responsibility for missing or damaged equipment, tools or personal belongings.

B. Workshop and Storage Facilities: The Contractor shall provide storage facilities for the protection from weather materials and supplies and shall keep the facilities clean and in proper order at all times.

C. Parking Facilities: Parking areas at the project location for the vehicles used by the Contractor's construction employees and his own vehicles shall be as approved by the Engineer.

3.02 SAFETY

A. The Contractor shall execute and maintain his work so as to avoid injury or damage to any person or property. All work shall be done in conformance with the State of California Division of Industrial Safety and OSHA Standards. Safety precautions, as applicable, shall include, but not be limited to, adequate fume protection; adequate illumination for underground and night operations; instructions in accident prevention for all employees; such machinery guards, walkways, scaffolds, ladders, bridges, and other safety devices, equipment and wearing apparel as are necessary or lawfully required to prevent accidents or injuries, and the proper inspection and maintenance of all safety measures. Contractor shall have emergency phone numbers and addresses posted on the job site.

3.03 TRENCH SAFETY

A. Contractor’s work shall conform to the provisions of Section 6705 of the Labor Code of the State of California.

1. Excavation for any trench 5 feet or more in depth shall not begin until the City has received the Contractor’s detailed plan for worker protection from the hazards of caving ground during the excavation of such trench.

2. Such plan shall be submitted at least 5 days before the Contractor intends to begin excavation for the trench and shall show the details of the design of shoring, bracing, sloping or other provisions to be made for worker protection during such excavation.

3. No such plan shall allow the use of shoring, sloping or a protective system less effective than that required by the Construction Safety Orders of the Division of Industrial Safety, and if such plan varies from the shoring system standards established by the Construction Safety Orders, the plan shall be prepared and signed by an Engineer who is registered as a Civil or Structural Engineer in the State of California.

4. In addition, the Contractor shall obtain, pay for and comply with all provisions of the permit required by Section 6500 of the California Occupational Safety and Health Act of 1973.

END OF SECTION

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SECTION 01520

FIELD OFFICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General description of section.

1. Requirements for the Construction Manager's office trailer, provided, furnished and maintained by the Contractor, including utilities and supplies, as specified herein.
2. The Construction Manager's office shall be located in close proximity to the Contractor's field office.
3. The location of both facilities (the Construction Manager's office trailer and Contractor's field office) shall be as directed by the Construction Manager.
4. Construction Manager's office trailer maintenance arrangements and utility connections shall be completed for occupancy within 15 days after Notice to Proceed, prior to submission of the first progress payment.
5. No initial payments for mobilization will be approved for work done under the contract until all field office requirements specified herein have been provided.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

1. Section 01330 – Submittals

1.03 SUBMITTALS

A. Provide manufacturer's product literature for the specialized office equipment in accordance with Section 01330.

1.04 CONSTRUCTION MANAGER'S OFFICE TRAILER

A. Office Trailer Requirements

1. The office shall be installed and in a location as directed by the Construction Manager.
2. The field office and its appurtenances or accessories shall remain the property of the Contractor.
3. Unless the Contractor is directed by the Construction Manager to remove the office at an earlier date, the office shall be disconnected from the utilities and removed from the site between twenty and thirty-five days after the Notice of Completion is recorded.
4. The office shall be insulated and of weather tight construction.

5. It shall be equivalent to a mobile trailer having an area of at least 250 square feet and be nominal 10’ wide.
6. Provide 8-foot-minimum ceiling height.
7. Provide floor tiles in each room.
8. The unit shall be rigidly mounted with accessory tie downs and installed level.
9. Stairs with a landing at floor level and handrails shall be provided. Provide portable chemical toilets with wash basin facilities.
10. Provide at least one window for each room. Provide blinds for windows.
11. Provide cylinder lock and key on each door.
12. Provide two sets of keys to the Construction Manager.
13. Line walls and ceiling with insulation.
14. Provide fluorescent type lights inside. At least 70 foot-candles of initial uniform lighting at desk level shall be provided in all rooms. Provide light switch in each room.
15. Provide an outside light near one of the entrance doors.
16. Provide adequate duplex 120-volt outlets in each room.
17. Provide refrigerated air conditioning and heating system for all rooms in the office space. HVAC system shall maintain a temperature indoors of 65°F to 80°F regardless of outdoor conditions at the site.
18. Provide separate sanitary facilities for CM staff and Contractor staff.
19. The Contractor shall be responsible for power connection of the new field office, and shall also remove the power at the conclusion of required service.

B. Provide Field Office Furnishings:

1. One 3’ x 5’ desk with drawers and locks per office.
2. One cushioned office swivel chair for desk per office.
3. Two cushioned chairs for visitors per office.
4. One metal filing cabinet, 18” W x 30” D x 52” H, four drawers with locks per office.
5. One bookcase, 12” D x 48” L, with one 12-inch-high shelf and one 18-inch-high shelf per office.
6. One wall-mounted white marker board, 4’ x 4’ minimum per office.
7. One wastebasket per office.
8. One full size copy machine, capable of reproducing up to 11 x 17 size sheets in both color and B&W, printing at least 16 sheets per minute.

1.05 CONSTRUCTOR'S FIELD OFFICE

A. During the performance of the Contract, the Contractor shall maintain a suitable office at the work site which shall be the headquarters of the Contractor's superintendent.

B. Office Trailer Requirements

1. The office shall be installed and operational the first day that the Contractor starts work at the project site, in a location as directed by the Construction Manager.

2. The field office and its appurtenances or accessories shall remain the property of the Contractor.

3. Unless the Contractor is directed by the Construction Manager to remove the office at an earlier date, the office shall be disconnected from the utilities and removed from the site between twenty and thirty-five days after the Notice of Completion is recorded.

4. The office shall be insulated and of weather tight construction.

5. It shall be equivalent to a mobile trailer having an area of at least 250 square feet and be nominal 10' wide and similar in amenities as specified for the Construction Manager's office trailer with refrigerated air conditioning and heating systems for all rooms in the office space.

6. Provide power connection of the new field office, and remove the power at the conclusion of required service.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 OFFICE TRAILER UTILITIES

A. Provide and maintain electrical power service to the office trailers.

B. All utility charges and bills shall be paid by the Contractor, including dedicated broadband line and service fees.

3.02 OFFICE TRAILER MAINTENANCE

A. Provide and pay for janitorial service for weekly maintenance and cleaning of the office trailers to the Construction Manager's satisfaction.

B. Provide and pay for replenishment of paper towels, soap, toilet paper, bottled drinking water, and cup supplies.

3.03 OPERATIONAL PERIOD

A. The office trailers shall remain on site and operational until Notice of Completion, or until receipt of notice from the Construction Manager, at which time the Contractor shall promptly remove utility connections from the office trailers.

B. The trailer site shall be graded, cleaned and restored to the satisfaction of the Construction Manager.

END OF SECTION

SECTION 01550

TRAFFIC CONTROL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for traffic control, nighttime work, traffic control plan, public notice, and signs.

B. Execute construction activities to maintain two-way traffic at all times unless otherwise approved.

1.02 DEFINITIONS

A. Traffic Control Devices: Signs, signals, markings and other devices placed on or adjacent to a road to regulate, warn or guide traffic.

B. Traffic Control Measures: Elements of the Traffic Control Plan including traffic control devices, personnel, materials, and equipment used to control traffic through the work Zone.

C. Traffic Control Plan: A written and drawn plan for handling traffic on a specific roadway through the Work Zone.

D. Work Zone: A traveled area within the construction used by vehicles, bicyclists and pedestrians.

1.03 CONTRACTOR RESPONSIBILITIES

A. Contractor's responsibilities for accommodating public traffic begin on the day any on-site work begins within the work limits. Contractor shall provide for the safety and convenience of the public. Contractor shall:

1. Be responsible for damages to property, injury to person, loss, expense, inconvenience, and delay caused by or resulting from any act, omission, or neglect of the Contractor, the Contractor's subcontractors and suppliers, or their employees while performing the work.

2. Conduct work at night time between the hours of 10:00 PM and 6:00 AM so that there is the least possible interference with, or hazard to, the traveling public and residents affected by the work.

3. Not perform work which would restrict or interrupt traffic movement on opposite sides of the traveled way at the same time.

4. Not stop or hold vehicles more than 5 minutes, or block driveways, intersections or connections for more than 5 minutes unless otherwise authorized in writing. More stringent time limits may be specified for specific locations within the Work area.

5. Submit proposed methods and lane closure times in each instance to the Engineer for approval with ample time to allow review of the submittal and issuance of notifications through the news media.

6. Obtain the Engineer's approval before closing any lanes or streets.

7. Not close any traffic or bike lane, or street, until the area is signed in accordance with the approved traffic Control Plan and the requirements of this Section.

8. Park construction equipment and vehicles or stockpile materials at least 30 feet from the traveled way. If this is not possible, protect the equipment, vehicles and stockpiled material with barriers or other satisfactory means.

9. Provide and maintain in a safe condition access to business and residence driveways, business and residence entrances during business operating hours.

10. Allow emergency vehicles, incident response units and transit vehicles immediate passage at all times.

1.04 TRAFFIC CONTROL REQUIREMENTS

A. Conduct work within City-owned right-of-ways in compliance with traffic control ordinances and permit requirements.

B. Provide and maintain temporary traffic control measures to provide for the safe passage of vehicular, bicycle, and pedestrian traffic through and within the Project site.

C. Under some circumstances, construction may temporarily prevent access into private driveways. Specifically identify this situation in the Traffic Control Plan and provide a plan for minimizing the temporary condition. When use of a private driveway extends beyond one day, construct temporary driveways using aggregate, place steel plates, or use other means to temporarily restore use of the driveway.

1.05 TRAFFIC CONTROL PLAN

A. Prepare and Submit a Traffic Control Plan

1. The determination of what protective devices and directional measures are required is the responsibility of the Contractor.

2. Identify proposed traffic control measures, signage and other traffic control devices, barricade locations, lane width reductions and lane shutdowns.

3. Do not start work within a Work Zone until the Traffic Control Plan has been accepted.

4. Implement the approved Traffic Control Plan.

1.06 PUBLIC NOTICE

A. Notify the following agencies at least 5 working days before implementing the approved Traffic Control Plan. In addition, notify agencies at least 3 days in advance of the implementation of any road closures or other restrictions that could cause delay to emergency vehicles.

1. City of Sacramento, Public Works Department.

2. City of Sacramento, Parks Department

3. City of Sacramento, Police Department.

4. City of Sacramento, Fire Department.

5. City of Sacramento, Shasta Park Library

6. Consumes River College.

B. Notify local residents at least 72 hours in advance of obstructions and inconvenience due to construction activities, including:

1. Obstruction of private driveways.

2. Elimination of on-street parking in front of private residences.

3. Any other similar inconvenience that may impact local residents.

1.07 TEMPORARY SIGNS

A. Provide and erect temporary traffic control signs of standard size and shape.

B. Erect informational signs advising pending work and lane closures two weeks in advance of actual work. Place information signs so that they are readable to both directions of travel.

C. Erect signs advising of rough road conditions when temporary pavement has been placed. Erect signs advising of steel plates in roadway when plates are in use.

D. When needed to advise traffic of approaching conditions, use electronic signs with sequential arrow or changeable message.

1. Install beyond the outside shoulder or behind an existing barrier or guardrail.

2. Display entire message within 7.5 seconds.

E. Do not use double-faced signs except for flagger STOP/SLOW sign paddles.

F. Temporary signs may be wooden or metal with tripod supports. Add sandbags to support legs for ballast.

1. When signs will remain in place after dark, provide signs with reflective fluorescent orange sheeting.

G. When the roadway is open during non-construction periods, remove non-applicable signs or cover with black plastic.

1.08 TEMPORARY BARRICADES

A. Install temporary barricades to protect vehicles from areas with drop-offs.

B. Concrete Barriers: Pin-and-loop type concrete barriers conforming to State Department of Transportation Standards.

C. Wooden Barricades: Industry standard with reflective devices and 8-inch diameter amber flashing light using one, 50-watt, 12-volt, battery operated incandescent lamp. Flash visible for 1200 feet.

1.09 FLAGGERS

A. Wear orange, yellow, yellow-green reflective vests and orange, yellow, yellow-green or white hardhat.

B. Utilize highly visible STOP/SLOW sign paddles with reflective sheeting.

C. Utilize portable, self-contained two-way radio when more than one flagger is used for traffic control.

D. Employ properly trained persons whom have completed an approved flagging course.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

A. Install, operate and maintain temporary traffic control devices in accordance with the Traffic Control Plan.

B. Move traffic control devices as construction progresses.

C. Turn, cover or remove existing permanent traffic control devices when they conflict with the temporary devices.

D. Remove temporary traffic control devices when no longer needed.

3.02 MAINTENANCE

A. Adequately maintain streets, sidewalks, and paved areas within the Work area for public traffic.

B. During construction, Contractor shall:

1. Keep surfaces being used by public traffic, pedestrians, and bicycles free of dirt, mud, gravel and other harmful materials. The surface includes sidewalks, bike paths, bike lanes, roadway shoulders or the outside 6 feet of the roadway.

2. Repair damage to surfaces caused by the Contractor's operations.

3. Maintain any detour or stage construction surfacing not constructed as specified or directed.

3.03 LANE CLOSURES

A. Do not close any lane until the area is signed in accordance with the Traffic Control Plan. Maintain as a minimum one open lane in each direction at all times on Bruceville Road.

B. Execute construction activities to maintain two-way traffic unless otherwise approved. When one lane must be closed on a two lane road, control one-way traffic by flaggers at all times.

C. At the end of each workday, restore conditions to allow two-way traffic. Install temporary paving to provide a minimum 11-foot wide traveled roadway in both

directions. Provide signs indicating rough road conditions when using temporary pavement.

D. Allow emergency vehicles immediate passage at all times.

3.04 TEMPORARY BARRICADES

A. Concrete Barriers

1. Flare the leading end at a flare rate of 14:1.

2. When placing concrete barriers, maintain a minimum of 24-inches from face of barrier to edge of traffic lane.

3.05 TEMPORARY TRENCH PLATING

A. Trench plating shall not be allowed except in special circumstances as approved by the Construction Manager. When approved, install temporary steel plates over trenches that are not backfilled by the end of the workday. Hydraulic shores shall not be used to maintain stability of the excavation faces when excavations are not backfilled and kept open overnight.

B. Place steel plates in a manner that provides at least 12 inches of bearing surface on all sides of the excavated trench.

C. Anchor steel plates to prevent shifting by applying cold mix asphalt around plate edges.

3.06 FLAGGERS

A. Provide flaggers to safely control movement of vehicles and pedestrians around areas disrupted by the Work.

B. Locate flaggers in positions that provide adequate time for motorists to respond to the flagger's instructions.

END OF SECTION

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SECTION 01560

ENVIRONMENTAL CONTROLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Environmental controls for air, water, soil, hazardous wastes, and biological resources.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials are specified in these Technical Specifications, and in Sections 10 through 38 of the CSSS.

B. Submit and obtain approval for all Submittals before commencing fabrications or moving construction materials onto the project site.

C. All equipment, material, and supplies called for on the Drawings and Specifications shall be new.

D. All equipment shall be complete, ready for installation, and tested to the satisfaction of the Engineer at the time of acceptance of the work.

E. Unless specifically excluded in the Contractor's Proposal, all incidental parts which are not shown on the Drawings, or specified herein, and which are necessary in order to have complete and operable facilities shall be furnished by the Contractor.

F. Manufactured articles, material, and equipment shall be applied, installed, connected, erected, adjusted, tested, used, cleaned, and conditioned as recommended by the manufacturer unless specified to the contrary. Copies of the manufacturer's installation instructions and procedures shall be submitted prior to the installation of manufacturer's articles, material, and equipment.

G. Materials and equipment shall be stored so as to insure the preservation of their quality and fitness for the work. Stores of equipment and materials shall be located to facilitate inspection. The Contractor shall be responsible for all damages that occur in connection with the care and protection of all materials and equipment until the completion of work and final acceptance by the City.

H. If any material does not conform with these specifications the Contractor shall, within three days after being notified by the Engineer, remove the materials from the project site or storage area.

PART 3 - EXECUTION

3.01 AIR POLLUTION CONTROL

A. The Contractor shall be required to reduce particulate emissions by complying with the Air Quality Management District's (AQMD) menu of potential dust suppression methods. Prepare a Dust Control Plan and provide the following measures as a minimum:

1. Enclose and cover all soil and sand blasting waste piles with geotextile mats to maintain dampness and prevent visible dust emissions. Cover shall consist of geotextile mats secured with driven pins.
2. Install sprinklers on all soil piles that are waiting to receive geotextile mats, or as determined by the Engineer, do not warrant cover with geotextile mats. Water as needed to maintain dampness and prevent visible dust emissions. The amount of watering may depend upon temperature, humidity, and wind speed for any given day.
3. Water all haul roads as needed to maintain dampness and prevent visible dust emissions. The amount of watering may vary depending upon temperature, humidity, and wind speed for a given day.
4. Maintain adequate freeboard or secure covering of all haul/dump trucks sufficient to prevent visible dust emissions and to prevent soil spillage on to surrounding roadways.

B. Contractor shall suspend grading, sand blasting operations, and paint coating operations on windy days that carry dust, sand, or paint aerosols off the project site.

C. The Contractor shall not discharge smoke, dust, and other contaminants into the atmosphere that violate the regulations of the AQMD. Internal combustion engines shall not be allowed to idle for prolonged periods of time. The Contractor shall maintain construction vehicles and equipment in good repair. Exhaust emissions that are determined to be excessive by the Engineer shall be repaired or replaced.

D. Prior to the use of any portable equipment containing an internal combustion engine, Contractor shall contract the AQMD Stationary Source Division for applicable registration requirements.

E. The Contractor shall be responsible for the control of dust within the limits of the project at all times including weekends and holidays in addition to normal working days. The Contractor shall take whatever steps are necessary or required by the Engineer to eliminate the nuisance of blowing dust.

F. The Contractor shall keep all streets as well as all grounds adjacent to the project site clean and free of dust, mud, and debris resulting from the Contractor's operations. Daily clean up throughout the project shall be required as the Contractor progresses with the work. Extra precautions and cleanup efforts shall be made prior to weekends and holidays.

G. Spillage of earth, gravel, concrete, asphalt, or other materials resulting from hauling operations along or across any public traveled way shall be removed immediately by the Contractor at his expense.

H. No separate payment will be made to the Contractor for dust control. The cost of such work shall be included in whatever bid item the Contractor deems appropriate.

3.02 NOISE CONTROL

A. Unless otherwise approved, construction involving noisy operations, including starting and warming up of equipment, shall be restricted to the hours between 7:00 A.M. and 6:00 P.M. on weekdays, and to the hours between 8:00 A.M. and 5:00 P.M. on Saturday. No work is allowed on Sunday.

B. The Contractor shall comply with applicable laws, regulations, and ordinances which apply to any work performed pursuant to the contract. If the requirements of this section are more restrictive than those of the local regulations, the requirements of this section shall govern.

C. Each internal combustion engine, used for any purpose on the job or related to the job, shall be enclosed and be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated on the project without said muffler and enclosure.

D. Contractor shall be required to locate all fixed construction equipment such as compressors and generators as far as feasibly possible from sensitive receptors. Contractor shall shroud or shield all impact tools.

E. Where possible, the Contractor shall use electric rather than diesel or gas-powered equipment.

F. There shall be no start-up of machines or equipment, no delivery of materials or equipment, no cleaning of machines or equipment and no servicing of equipment except during the permitted hours of construction involving noisy operations.

G. Amplified sound and other forms of loud communication constituting a nuisance, at the sole discretion of the Construction Manager, shall not be permitted.

3.03 WATER CONTROL

A. The Contractor shall be responsible for keeping trenches and other areas free from water as required to permit continuous progress of, or to prevent damage to, its own work or the work of others. The Contractor's operations shall be conducted in such a manner as to prevent sediment from reaching existing sewers, storm drains, and the deep water channel.

B. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other means. This requirement extends to temporary works required to protect adjoining properties from surface drainage caused by construction operations.

C. Implement the appropriate level of surface water control to protect water quality throughout the construction period. Utilize Best Management Practices throughout the construction period.

D. The Contractor shall cover exposed excavated areas and spoils piles when runoff from rain is or would be likely to cause turbidity to enter local waterways or the stormwater collection system. The Contractor shall suspend work in the rain if such work cannot be performed without causing turbid runoff.

E. Water used for disinfection purposes or other water with a chlorine residual greater than 0.1 mg/L shall not be discharged to any water body or ditch or allowed to enter the City stormwater collection system. Remove all chlorine residual by adding dechlorinating chemicals. Obtain prior approval of City (or other agencies with jurisdiction over discharge) of chlorine removal system, controls, and procedures.

3.04 DEWATERING

A. Obtain all necessary permits, including those required by California Department of Water Resources (DWR), and the County Department of Public Health for dewatering wells and monitoring wells, those required by the State Water Resources Control Board Water Quality Order No. 2003-003-DWQ and Central Valley Region Water Quality Control Board General Order No. R5-2008-0081 Waste Discharge Requirements for Dewatering and Other Low Threat Discharges to Surface Waters for discharge of groundwater to stormwater facilities.

B. Design of the dewatering system shall be prepared by a professional civil, structural or geotechnical engineer registered in the state of California and shall be coordinated with the design of the excavation support systems that the Contractor proposes to use at these locations.

C. Comply with the sampling, testing, monitoring, and reporting requirements specified in permits secured for dewatering operations. Pay all costs associated with permitting, decommissioning and removal of all dewatering systems when no longer in use.

D. Design dewatering systems of sufficient scope, size, and capacity to control the flow of surface water into trench and structure excavations by grading, dikes, or other means.

   a. Lower groundwater levels and eliminate infiltration of groundwater into trench and structure excavations, allowing construction to proceed on dry, stable subgrade.

   b. Lower and maintain groundwater to a level at least three feet below the lowest point of excavations.

   c. Lower groundwater levels further when necessary to obtain the specified degree of compaction. Develop substantially dry and stable subgrade for subsequent earthwork compaction and construction operations.

   d. Prevent the loss of fines, seepage, boils, quick conditions, or softening of the foundation soils.

   e. Maintain stability of sides and bottoms of excavations.

E. Before dewatering is commenced, the Contractor shall obtain acceptance of the Engineer for the method, installation, monitoring, testing, removal, discharge point(s) and other system details of the Contractor's proposed dewatering system. To that end, the Contractor is to submit to the Engineer a complete dewatering plan prepared and signed by a Professional Engineer registered in California.

F. The Contractor will be held responsible for any fines or penalties from regulatory agencies resulting from its dewatering system.

3.05 HAZARDOUS MATERIAL PREVENTION AND CONTROL

A. GENERAL

1. The Contractor shall be responsible for prevention, containment, and cleanup of spilling of oil, fuel, and other hazardous products used in the Contractor's operations, and implement a hazardous materials management, spill prevention, and spill response cleanup program. All such prevention, containment, and cleanup costs shall be borne by the Contractor. The Contractor shall not discharge oil, fuel, or other hazardous products from equipment or facilities into surrounding waters or onto adjacent land.

B. SPILL MITIGATION MEASURES

1. The Contractor shall, at a minimum, take the following measures regarding oil spill prevention, containment, and cleanup:

   a. Fuel hoses, lubrication equipment, hydraulically operated equipment, oil drums, and other equipment and facilities shall be inspected regularly for drips, leaks, or signs of damage, and shall be maintained and stored properly to prevent spills and stored in locked containers to discourage vandalism.

   b. All land-based oil and products storage tanks shall be diked or located so as to prevent spills from escaping to the water. Diking and subsoils shall be lined with impervious material to prevent oil from seeping through the ground and dikes.

   c. All visible oils on land shall be immediately contained using dikes, straw bales, or other appropriate means and removed using sand, ground clay, sawdust, or other absorbent material, which shall then be properly disposed of by the Contractor. Waste materials shall be temporarily stored in drums or other leak proof containers after cleanup and during transport to disposal. Waste material shall be disposed off property at an approved site.

C. HAZARDOUS MATERIAL MANAGEMENT

1. The Contractor shall, at a minimum, take the following hazardous materials measures regarding spill prevention and response, containment, and cleanup:

   a. Delineate all hazardous material and hazardous waste storage areas, access and egress routes, drainage paths, emergency assemble areas, and temporary hazardous waste storage areas.

   b. Provide and maintain on site files with material safety data sheets for all chemicals used at the construction site.

   c. Provide spill control and countermeasures for spill prevention and response, containment, and cleanup.

   d. Provide employee spill prevention/response training.

e. Provide and maintain an onsite inventory of emergency spill response, containment, and cleanup equipment.

f. Provide off-loading, safety, and handling procedures for each chemical used at the construction site.

g. Provide notification procedures in the event of a chemical spill.

h. Provide documentation forms and procedures for spill response and cleanup.

3.06 STORM WATER QUALITY CONTROLS

A. GENERAL

1. The 1972 amendments to the Federal Water Pollution Control Act established the National Pollutant Discharge Elimination System (NPDES) permit program to control discharges of pollutants from point sources. The 1987 amendments to the Clean Water Act (CWA) created a new section of the CWA devoted to storm water permitting (Section 402(p)). The EPA has delegated permitting authority to the State Water Resources Control Board (SWRCB). The SWRCB issues both general and individual permits. Construction activities are regulated under the NPDES General Permit for Storm Water Discharges Associated with Construction Activity (General Permit) provided the total amount of ground disturbance during construction is greater than or equal to 1 (one) acre. The appropriate Regional Water Quality Control Board (RWQCB) enforces the General Permit. Coverage under a General Permit requires the submission of a Notice of Intent (NOI) with the appropriate fee, annual compliance reports, a Notice of Termination (NOT) and preparation of a Storm Water Pollution Prevention Plan (SWPPP).

2. Construction activity includes, but is not limited to: clearing, grading, demolition, excavation, construction of new structures, pipelines and reconstruction of existing facilities involving removal and replacement that results in soil disturbance. This includes construction access roads, staging areas, storage areas, stockpiles, and any off-site areas which receive run-off from the construction project such as discharge points into a receiving water.

3. While the City will be responsible to the RWQCB for causing the preparation of and compliance with the various management plans called for in the permit, the City will require the Contractor to provide the detail planning and compliance activities required insofar as they would potentially affect the Contractor's methods and means of performing the Work.

4. If a violation of the permit is due to the Contractor's actions or inactions and a fine is assessed, the Contractor shall be responsible for the fine.

5. A copy of the Fact Sheet for the General Permit, the General Permit, and the NOI, are available on the SWRCB website at: http://www.swrcb.ca.gov/water_issues/programs/stormwater/.

B. CONTRACTOR'S RESPONSIBILITIES

1. The Contractor shall comply with the SWRCB, RWQCB, County, City, and other local agency requirements regarding stormwater management, inspection, and monitoring.

2. The Contractor shall be responsible for meeting the requirements of the General Permit except as specifically noted below. The Contractor shall prepare the following documents in accordance with Section C, STANDARD PROVISIONS FOR CONSTRUCTION ACTIVITY, of the General Permit and submit them to the City as follows:

   a. Provide information to the City as necessary to complete the NOI.

   b. Prepare and submit the SWPPP for City review at least 30 days prior to any soil disturbing construction in accordance with Section A: STORM WATER POLLUTION PREVENTION PLAN of the General Permit. The Plan shall follow the format presented in the California Storm Water Best Management Practices (BMP) Handbook - Construction Activity volume, available from the Blue Print Service, 1700 Jefferson Street, Oakland, California 94612. The plan must address all areas outside of the Project site that are disturbed by Contractor for the prosecution of the Work.

   c. Install, construct, implement, monitor, maintain and remove upon completion all of the BMPs and other pollution prevention measures in accordance with Section A: STORM WATER POLLUTION PREVENTION PLAN of the General Permit.

   d. Prepare the annual compliance report and submit to the City prior to review as required by Section B, Item 4. – Compliance Certification of the General Permit.

   e. Prepare all inspection and monitoring reports in accordance with Section B, items 3 through 6 of the General Permit and submitting them to the City for review.

   f. Prepare NOI for Engineer and City review. The City will file the NOI; however, the Contractor shall certify the NOI.

   g. Provide evidence to the Engineer that the individual responsible for the SWPPP preparation, implementation, and permit compliance has been appropriately trained and has attended training and/or workshops offered by the SWRCB, RWQCB, or other locally recognized agencies or professional organizations. All workers on-site shall, at a minimum, have received training from the responsible individual.

   h. Contractor shall provide the Engineer the names and 24-hour phone numbers for parties responsible for implementing, monitoring, inspecting and maintaining the SWPPP.

   i. All documents prepared by the Contractor shall be routed through the City, via the Engineer, for submission to the RWQCB.

   j. Contractor shall be bound to the conditions on the Notice of Intent (NOI) that will be filed by City and will be responsible for all costs associated with the implementation of the Plan including all fines,

damages and job delays incurred due to failure to implement the requirements of the Permit.

k. Contractor shall maintain a copy of the NOI, Plan and Permit at the Project Site at all times, and shall make the Plan available to City, Engineer, and the State Water Quality Control Board during construction activities. Contractor shall allow authorized agents of the Water Quality Control Board, State Water Resources Control Board, U.S. Environmental Protection Agency, and local storm water management personnel upon the presentation of credentials and other documents as may be required by Laws and Regulations to accomplish the following:

1) Enter, at reasonable times, upon the construction site and Contractor's facilities pertinent to the Work.

2) Have access to and copy, at reasonable times, any records that must be kept as specified in the permit.

3) Inspect, at reasonable times, the construction site and related erosion and sediment control measures.

4) Sample or monitor, at reasonable times, for the purpose of ensuring compliance with the Permit.

5) Contractor shall notify the Engineer immediately following a request from any regulatory agency to enter, inspect, sample, monitor or otherwise access the Project Site or its records.

l. The Contractor shall be responsible for taking the proper actions to prevent stormwater coming into contact with contaminants and sediments from migrating offsite or entering storm sewer drainage systems. The Contractor shall take immediate action if directed by the Engineer or if the Contractor observes contaminants and/or sediments entering the storm drainage system, to prevent further stormwater from entering the system.

m. The Contractor shall update the SWPPP whenever there is a change in construction or operation.

C. CITY RESPONSIBILITIES

The City shall be responsible for the following:

1. File the Notice of Intent (NOI) that has been prepared and certified by the Contractor.

2. Furnish the Contractor with base maps of a suitable scale in order to satisfy the requirements of the General Permit.

3. The City will submit to the RWQCB an annual summary report and pay the associated fee. This annual summary report will require the submission of the annual certification and update as required in Contractor's responsibilities above.

4. Furnish text and calculations for Post-Construction Storm Water Management of the General Permit.

5. Signatory responsibility as defined in Section C – Signatory Requirements of the General Permit.

6. File the Notice of Termination Form (NOT) and the Contractor's post-construction BMP's plan when all portions of the site have been transferred to the City upon Final Acceptance of the Work. The Contractor shall be responsible for meeting the requirements of the General Permit except as specifically noted below. The Contractor shall prepare the following documents in accordance with Section C, STANDARD PROVISIONS FOR CONSTRUCTION ACTIVITY, of the General Permit and submit them to the City as follows:

3.07 SPECIFIC STORMWATER POLLUTION PREVENTION MEASURES

A. The Contractor is responsible for implementing the project SWPPP (Storm Water Pollution Prevention Plan). The Contractor shall provide a QSP (Qualified Stormwater Practitioner) to manage the SWPPP implementation. The City QSD (Qualified Stormwater Developer) is responsible for changes to the SWPPP and will periodically review the Contractor's implementation practices.

1. This project has an Erosivity waiver for preparation of a SWPPP (Storm Water Pollution Prevention Plan). The Contractor shall provide a QSP (Qualified Stormwater Practitioner) to manage the BMP implementation.

2. As a minimum implement the following minimum Storm Water Pollution Prevention Best Management Practices:

B. Build perimeter silt control during construction by one or more of the following methods:

1. Silt Fence (CASQA BMP SE-1)

2. Fiber Rolls (CASQA BMP SE-5)

C. Cover all exposed earth surfaces if left inactive for longer than 14 calendar days, with geotextile mats. Erosion control mats shall comply with CASQA EC-7, 100% coverage.

D. Perform Street Sweeping and cleanup on a daily basis (CASQA SE-7).

E. Provide Storm Inlet protection at all existing downstream drainage inlets (CASQA SE-10).

F. Provide Wind Erosion control, especially when winds in excess of 10 mph are predicted (CASQA WE-1).

G. Provide Stabilized Construction Entrance/Exit (CASQA TC-1).

H. Take protective actions during Paving and Grinding Operations (CASQA NS-3).

I. Perform Vehicle and Equipment Cleaning offsite or per CASQA NS-8.

J. Perform Vehicle and Equipment Fueling offsite or per CASQA NS-9.

K. Perform all Vehicle and Equipment Maintenance offsite or per CASQA NS-10.

L. Comply with the requirements of CASQA WM-1 and WM-2 for Material Delivery and Storage and Material Use.

M. Comply with the requirements of CASQA WM-3 for Material Stockpile Management.

N. Perform Spill Prevention and Control as needed (CASQA WM-4).

O. Perform Solid Waste and Hazardous Waste Management per CASQA WM-5 and WM-6.

P. Perform Concrete Waste Management per CASQA WM-8.

Q. Perform Sanitary/Septic Waste Management by providing onsite portable toilet facilities (CASQA WM-9).

R. Cover all exposed earth surfaces prior to completion of project by one or more of the following methods:

1. Hydroseeding (CASQA EC-4) to achieve 90% germination and growth, including irrigation if during non-rainy months.

2. Landscaping mulch (CASQA EC-8), 100% coverage.

3.08 CITY SPECIFIC STORMWATER POLLUTION PREVENTION MEASURES

A. At a minimum, the Contractor shall provide protection around any drain inlets located within the project area and any cross streets which receive runoff from the limits of the construction zone. The Contractor shall also exercise care during trench excavation so that excessive sediments are not tracked into the gutters and ultimately, the storm drain. Upon completion of the project, all areas within the limits of the project shall be cleaned and free of sediments.

B. The Contractor will not be allowed to clean the sediments from the street by means of using a water truck to spray the streets down into the storm drain via curb and gutter. The streets will be allowed to be sprayed by a water truck only when sediment barriers have been placed at drainage inlets to catch all sediments from the streets. The Contractor shall prepare and submit to the Engineer for review and approval a drawing showing the placement of sediment control barriers, drop inlet protection, housekeeping practices and any other measures proposed to be used to prevent sediment and other sources of pollution from entering the City storm drainage system.

1. Housekeeping Practices

a. Contractor shall implement housekeeping practices during the construction of this project. The Contractor is required to implement, at a minimum, the following housekeeping practices: solid waste management, material storage and delivery area, concrete waste management, and spill prevention and control.

b. **Solid Waste Management:** Contractor shall maintain a clean construction site. Contractor shall provide designated areas for waste collection. The waste collection areas shall be leak-proof containers with lids or covers. Site trash shall be collected daily and placed in the disposal containers. The Contractor shall make arrangements for regular waste collection. The Contractor shall also regularly inspect the waste disposal areas to determine if potential pollutant discharges exist.

c. **Material Storage and Delivery Area:** Contractor shall provide one central material storage and delivery area for the duration of the project. This area shall be fenced and protected such that runoff will not be allowed to leave the material storage area. The

Contractor shall regularly inspect the site to ensure that any hazardous or non-hazardous materials have not spilled.

d. **Concrete Waste Management:** The Contractor shall arrange for concrete wastes to be disposed of off-site or in one designated area. Concrete wastes, including left-over concrete and material from washing out the concrete truck, shall not be disposed to the storm drain system via curb and gutter. If a designated area is provided, the site shall be bermed to allow the concrete to dry. The dried concrete waste shall be removed and disposed of properly at the Contractor's expense.

e. **Spill Prevention and Control:** The Contractor shall be responsible for instructing employees and sub-contractors about preventing spills of hazardous materials and controlling spills if they occur. Proper spill control and cleanup materials shall be kept on site near the storage area and updated as materials change on site.

f. More information about Housekeeping Practices can be obtained by referring to the City of Sacramento's Administrative and Technical Procedures Manual for Grading, Erosion and Sediment Control dated January 1994, available at 1395 35th Avenue, Sacramento, CA 95822. (Revised 5\30\96)

3.09 ARCHAEOLOGICAL RESOURCES

A. If subsurface archaeological or historical remains are discovered during construction, work in the area shall stop immediately and a qualified archaeologist and a representative of the Native American Heritage Commission shall be consulted to develop, if necessary, further mitigation measures to reduce any archaeological impact to a less than significant level before construction continues.

B. If human burials are encountered, all work in the area shall stop immediately and the Sacramento County Coroner’s office shall be notified immediately. If the remains are determined to be Native American in origin, both the Native American Heritage Commission and any identified descendants must be notified and recommendations for treatment solicited (CEQA Section 15064.5); Health and Safety Code Section 7050.5; Public resources Code Section 5097.94 and 5097.98.

3.10 BURROWING OWL PROTECTION

A. Contractor shall hire a qualified biologist (California Department of Fish and Game approved) to conduct a California Department of Fish and Game (CDFG) protocol western burrowing owl nesting survey. Surveys shall be conducted within 30 days prior to any construction. If no active nests are found, no further nesting mitigation is required.

B. If western borrowing owl nests are found within 250 feet of the construction area, the Contractor shall delay start of construction until passive relocation is accomplished.

END OF SECTION

SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements Included:

1. Products.
2. Transportation and Handling.
3. Storage and Protection.
4. Substitutions and Product Options.

1.02 REFERENCED SECTION

A. The following Section is referenced in this Section:

1. Section 01330 – Submittals

1.03 SUBMITTALS

A. Comply with Section 01330.

B. Submit Manufacturers' Certificates.

1.04 QUALITY ASSURANCE

A. Include within the Contractor's quality assurance program such procedures as are required to assure full protection of work and materials.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Manufacturer's Recommendations:

1. Except as otherwise approved by the Engineer, determine and comply with manufacturer's recommendations on product handling, storage and protection.
   a. Maintain packaged materials with seals unbroken and labels intact until time of use.
   b. Promptly remove damaged materials and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to the City.
2. The Engineer may reject as non-complying such material and products that do not bear identification satisfactory to the Engineer as to manufacturer, grade, quality, and other pertinent information.
3. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.

1.06 JOB CONDITIONS

A. Storage and Protection:

1. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instructions.

2. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

3. Store loose granular materials on solid surfaces in a well-drained area; prevent mixing with foreign matter.

4. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

5. After installation, provide coverings to protect products from damage from traffic and construction operations, remove when no longer needed.

6. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by the City.

B. Repairs and Replacements:

1. In event of damage, promptly make replacements and repairs to the approval of the Engineer and at no additional cost to the City.

2. Additional time required to secure replacements and to make repairs will not be considered to justify an extension in the Contract Time of Completion.

1.07 ALTERNATIVES

A. Product Options:

1. Within 10 days after date of Contract, submit complete list of major products proposed, with name of manufacturer, trade name, and model.

2. Options:

a. Products Specified by Reference Standards or by Description Only: Any product meeting those standards.

b. Products Specified by Naming One or More Manufacturers with a Substitute Paragraph: Submit a request for substitution for any manufacturer not specifically named.

c. Products Specified by Naming Several Manufacturers: Products of named manufacturers meeting specifications; no options, no substitutions allowed.

d. Products Specified by Naming Only One Manufacturer: No options, no substitutions allowed.

B. Substitutions:

1. Within 10 calendar days after date of Contract, Contractor shall submit requests to the Engineer for consideration of substitutions.
2. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
3. Request constitutes a representation that Contractor:
    a. Has investigated proposed product and determined that it meets or exceeds, in all respects, specified product.
    b. Will provide the same warranty for substitution as for specified product.
    c. Will coordinate installation and make other changes that may be required for Work to be complete in all respects.
    d. Waives claims for additional costs that may subsequently become apparent.
4. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals without separate written request, or when acceptance will require substantial revision of Contract Documents.
5. Engineer will determine acceptability of proposed substitution, and will notify Contractor of acceptance or rejection in writing within a reasonable time.
6. The Engineer can, at his option, require as a condition of acceptance of a substitution that the Contractor provide a credit to the City for the difference in cost of product(s) or components, or systems proposed as a substitution.
7. If, upon Engineer's review of a substitution, it is determined by the Engineer that the substitution is not acceptable, for whatever reason, the Contractor shall supply the specified product or products.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SHIPPING AND PROTECTION OF EQUIPMENT

A. Definition: For the purpose of this article, "equipment" means all mechanical devices, all electrical devices, and all items with one or more moving parts.

B. Packing and Marking: All equipment shall be adequately and effectively protected against damage from moisture, dust, handling or other cause during transport from manufacturer's or supplier's premises to site. Each item or package shall be clearly marked with a fitting or distinguishing mark that shall be shown on the packing lists. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or sub-assembled units where possible.

C. Identification of Equipment: Each item of equipment shall have firmly affixed to it a nameplate, label or tag with its equipment number or other discrete identifying mark.

D. Storage of Equipment: Contractor shall provide storage for equipment; for the entire interval between receiving and installation, and for the entire interval between being removed and reinstalled. Equipment shall be stored in an enclosed space affording protection from weather, dust and mechanical damage and providing favorable temperature, humidity and ventilation conditions as required to ensure against equipment deterioration. Storage container shall be heated above dew point temperature.

E. Protection of Equipment After Installation: After installation, all equipment shall be protected as required. During construction, including finishing, all equipment that may be affected must be completely covered.

F. Delivery of Equipment: City personnel will not accept materials or equipment deliveries for the Contractor.

G. Security: Security of equipment stored by the Contractor is his responsibility. All losses or damage shall be replaced or repaired at the Contractor's expense.

END OF SECTION

SECTION 01662

COMMISSIONING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section contains requirements for the commissioning of the facility. All commissioning work, as described in this section, shall be performed by the Contractor.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 COMMISSIONING PERIOD

A. After completion of the operational test, the Contractor shall remove all temporary piping, controls and other alterations to the permanent systems that may have been needed during the facility testing and shall perform the tasks necessary to make the improvements constructed under this contract fully operational.

B. The commissioning period system shall be continuous period of 28 days. Should the commissioning period be interrupted at any time due to the Contractor's work, the commissioning period shall be restarted from the beginning of the full 28 day period. No additional compensation will be provided.

C. During the commissioning period, the City shall be responsible for all normal operational costs and the Contractor shall bear the costs of all necessary repairs or replacements, including labor and materials, required to keep the facility operational.

D. The Contractor shall be available at all times during commissioning periods to provide immediate assistance in case of trouble or failure of any portion of the facility. The commissioning period shall be considered ended when all corrections required by the Engineer to assure a reliable and completely operational facility are complete. The completion of the commissioning period is required prior to final acceptance.

3.02 FACILITY CLEANUP

A. Prior to final acceptance of the facility, the Contractor shall clean the facility. This shall include at a minimum the following:

1. Removal of concrete, asphalt or mud from any metal, painted surfaces or concrete block
2. Wash down of the asphalt to remove dirt or mud
3. Removal of any project debris, equipment or stockpiles of material that the City does not want
4. Wipe down of the interior of control building to remove surface dust

5. Removal of debris and dusting all electrical, sample station and generator enclosures
6. Removal of mud and debris from all underground vaults
7. Clean all debris from the concrete reservoir roof and welded steel tank
8. Clean the gutter of the control building
9. Remove debris, leaves and trash from the landscaping areas

END OF SECTION

SECTION 01725

PROTECTION OF EXISTING FACILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Protection of all existing utilities and improvements not designated for removal and restoration of damaged or temporarily relocated utilities and improvements to a condition equal to or better than prior to such damage or temporary relocation in accordance with the Contract Documents.

1.02 NOTIFICATION BY THE CONTRACTOR

A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, the Contractor shall notify the respective authorities representing the owners or agencies responsible for such facilities not less than 3 days nor more than 7 days prior to excavation so that a representative of said owners or agencies can be present during such work.

1.03 RIGHTS-OF-WAY

A. The Contractor shall not do any work that would affect any oil, gas, sewer, or water pipeline; and telephone, or electric transmission line; any fence; or any other structure, nor shall the Contractor enter upon the rights-of-way involved until notified that the Owner has secured authority therefor from the proper party.

B. After authority has been obtained, the Contractor shall give said party due notice of its intention to begin work, if required by said party, and shall remove, shore, support, or otherwise protect such pipeline, transmission line, ditch, fence, or structure, or replace the same.

1.04 PROTECTION OF STREET OR ROADWAY MARKERS

A. The Contractor shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization.

B. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced.

C. Survey markers or points disturbed by the Contractor shall be accurately restored after street or roadway resurfacing has been completed.

1.05 RESTORATION OF PAVEMENT

A. General

1. All paved areas including asphaltic concrete berms cut or damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract Documents or in the requirements of the agency issuing the permit.

2. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement.

3. Temporary and permanent pavement shall conform to the requirements of the affected pavement owner.

4. Pavements that are subject to partial removal shall be neatly saw cut in straight lines.

B. Temporary Resurfacing

1. Place temporary surfacing promptly after backfilling and maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

C. Permanent Resurfacing

1. In order to obtain a satisfactory junction with adjacent surfaces, saw cut back and trim the edge so as to provide a clean, sound, vertical joint before permanent replacement of an excavated or damaged portion of pavement.

2. Damaged edges of pavement along excavations and elsewhere shall be trimmed back by saw cutting in straight lines.

3. All pavement restoration and other facilities restoration shall be constructed to finish grades compatible with adjacent undisturbed pavement.

D. Restoration of Sidewalks or Driveways

1. Wherever sidewalks or roads have been removed for purposed of construction, place suitable temporary sidewalks or roadways promptly after backfilling and maintain them in satisfactory condition until the final restoration thereof has been made.

1.06 EXISTING UTILITIES AND IMPROVEMENTS

A. General: Protect underground utilities and other improvements which may be impaired during construction operations, regardless of whether or not the utilities are indicated on the Plans.

B. Take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

C. Except where the Plans indicate utilities have been field located during design or certain utility locations shall be exposed as part of the work, the Contractor shall be responsible for exploratory excavations as it deems necessary to determine the exact locations and depths of utilities which may interfere with its work.

1. All such exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of construction to avoid possible delays to the Contractor's progresses.

2. When such exploratory excavations show the utility location as shown on the Plans to be in error, the Contractor shall so notify the Engineer.

D. Existing utilities and tie-ins

1. Are assumed to be accurate to within one-foot (plus or minus) vertical and five-feet (plus or minus) horizontal position.

2. No additional compensation will be made for utilities and tie-ins within that accuracy.

E. Excavations and Trenching

1. Maintain a 1:2 horizontal distance from any existing pole as determined by the depth of the trench.

2. If trenching encroaches on this requirement, the Contractor shall contact the Engineer and Roseville Electric to brace any effected poles during the trenching process.

3. The cost of any required pole bracing shall be borne by the Contractor.

F. Potholing

1. Required at the connection to existing facilities prior to the shop drawing submittals, and as required to identify utilities not previously located on the plans.

2. Utility location shall be accomplished at least ten working days in advance of the date of construction.

3. Any discrepancies between the location of a utility found by the potholing operation than that shown on the Plans shall be brought to the Engineer's attention immediately.

4. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility.

G. Utilities to be Moved

1. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of the Contractor, be notified by the Owner to move such property within a specified reasonable time.

2. When utility lines that are to be removed are encountered within the area of operations, the Contractor shall notify the Engineer a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.

H. Utilities to be Removed

1. Where proper completion of the work requires the temporary or permanent removal and/or relocation of an existing utility or other improvement which is indicated, the Contractor shall remove and, without

unnecessary delay, temporarily replace or relocate such utility or improvement in a manner satisfactory to the Engineer and the owner of the facility.

2. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by the Contractor in a manner that will restore or replace the utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

I. Owner's Right of Access

1. The right is reserved to the Owner and to the owners of public utilities and franchises to enter at any time upon any public street, alley, right-of-way, or easement for the purpose of making changes in their property made necessary by the work of this Contract.

J. Underground Utilities Indicated

1. Existing utility lines that are indicated or the locations of which are made known to the Contractor prior to excavation and that are to be retained, and all utility lines that are constructed during excavation operations shall be protected from damage during excavation and backfilling and, if damaged, shall be immediately repaired or replaced by the Contractor, unless otherwise repaired by the owner of the damaged utility.

2. If the owner of the damaged facility performs its own repairs, the Contractor shall reimburse said owner for the costs of repair.

K. Underground Utilities Not Indicated

1. In the event that the Contractor damages existing utility lines that are not indicated or the locations of which are not made known to the Contractor prior to excavation, a verbal report of such damage shall be made immediately to the Engineer and a written report thereof shall be made promptly thereafter.

2. The Engineer will immediately notify the owner of the damaged utility. If the Engineer is not immediately available, the Contractor shall notify the utility owner of the damage.

3. If directed by the Engineer, repairs shall be made by the Contractor under the provisions for changes and extra work contained in the General Conditions.

L. Costs of locating and repairing damage not due to failure of the Contractor to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Contract Documents with reasonable accuracy, and for equipment on the project which was actually working on that portion of the work which was interrupted or idled during such work will be paid for as extra work in accordance with the provisions of the General Conditions.

M. Approval of Repairs

1. All repairs to a damaged utility or improvement are subject to inspection and approval by an authorized representative of the utility or improvement owner before being concealed by backfill or other work.

N. Maintaining in Service

1. Unless indicated otherwise, gas pipelines, power, and telephone or communication cable ducts, water mains, irrigation lines, sewer lines, storm drain lines, poles, and overhead power and communication wires and cables encountered along the line of the work shall remain continuously in service during all the operations under the Contract, unless other arrangements satisfactory to the Engineer are made with the owner of said pipelines, duct, main, irrigation line, sewer, storm drain, pole, or wire or cable.

2. The Contractor shall be responsible for and shall repair all damage due to its operations, and the provisions of this Section shall not be abated even in the event such damage occurs after backfilling or is not discovered until after completion of the backfilling.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 01750

TESTING, TRAINING AND FACILITY START-UP

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. General description of section.

1. Section Includes: Equipment and system testing and start-up, services of manufacturer's representatives, training of City personnel, and final testing requirements for the completed facility.

1.02 CONTRACT REQUIREMENTS

A. Testing, training, and start-up are requisite to the satisfactory completion of the Contract. Complete testing, training, and start-up within the Contract Time. Allow realistic time frame for testing, training, and start-up activities.

B. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.

C. Provide competent, experienced technical representatives of equipment manufacturers for assembly, installation and testing guidance, and operator training.

1.03 START-UP PLAN

A. Submit start-up plan for each piece of equipment and each system not less than three (3) weeks prior to planned initial equipment or system start-up.

1. Provide detailed information and schedule for the following activities:

a. Manufacturer's services
b. Installation certifications
c. Operator training
d. Completion of Operation and Maintenance Manual
e. Functional testing
f. Performance testing
g. Operational testing

B. Provide testing plan with test logs for each item of equipment and each system when specified. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.

C. Provide summary of shutdown requirements for existing systems which are necessary to complete start-up of new equipment and systems.

D. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.04 PERFORMANCE TESTING

A. Test equipment for proper performance at point of manufacturer of assembly when specified.

B. When Source Quality Control Testing is Specified:

1. Demonstrate equipment meets specified performance requirements.

2. Provide certified copies of test results.

3. Do not ship equipment until certified copies have received written acceptance from Engineer. Written acceptance does not constitute final acceptance.

4. City include costs associated with witnessing performance tests in the bid price. Include costs for one (1) Owner's representative for travel, lodging, transportation to and from lodging, and fifty (50) Dollars meal allowance per person per day.

1.05 GENERAL START-UP AND TESTING PROCEDURES

A. Mechanical Systems:

1. Remove rust preventives and oils applied to protect equipment during construction.

2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by manufacturer.

3. Flush fuel system and provide fuel for testing and start-up.

4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.

5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.

6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.

7. Perform cold alignment and hot alignment to manufacturer's tolerances.

8. Adjust v-belt tension and variable pitch sheaves.

9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to insure no leakage, but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.

10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.

11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.

B. Electrical Systems: As specified in Division 16.

C. Instrumentation Systems: As specified in Division 16.

1.06 FUNCTIONAL TESTING

A. Functionally test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed.

B. Verify compatibility of new equipment with existing: Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration.

C. Perform initial checks in the presence of and with the assistance of manufacturer's representative.

D. Demonstrate proper operation of each instrument loop function as specified in Division 16.

E. Conduct continuous eight (8) hour test under full load conditions. Replace parts which operate improperly.

1.07 CERTIFICATION OF PROPER INSTALLATION

A. At completion of functional testing, furnish written report prepared and signed by manufacturer's authorized representative, certifying equipment:

1. Has been properly installed, adjusted, aligned, and lubricated.
2. Is free of any stresses imposed by connections or anchor bolts.
3. Is suitable for satisfactory full-time operation under full load conditions.
4. Operates within the allowable limits for vibration.
5. Controls, protective devices, instrumentation, and control panels are properly installed, calibrated, and functioning.
6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown have been tested and are properly functioning.

B. Co-sign the reports along with the manufacturer's representative and subcontractor.

1.08 TRAINING OF OWNER'S PERSONNEL

A. Provide approved operations and maintenance training for items of mechanical, electrical and instrumentation equipment. Utilize manufacturer's representatives to conduct training sessions.

B. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than two (2) sessions per week.

C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems two (2) weeks prior to training session for that piece of equipment or system.

D. Satisfactorily complete functional testing before beginning operator training.

E. Schedule training sessions during the time periods shown. Monday – Friday:7 a.m. – 12 p.m.; 1 p.m.-3:30 p.m.

1.09 OPERATIONAL TESTING

A. Conduct operational test of the entire facility after completion of operator training. Demonstrate satisfactory operation of equipment and systems in actual operation. Conduct operational test for continuous seven (7) day period.

B. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.

C. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.10 RECORD KEEPING

A. Maintain and submit following records generated during start-up land testing phase of project:

1. Daily logs of equipment testing identifying all tests conducted and outcome.

2. Logs of time spent by manufacturer's representatives performing services on the job site.

3. Equipment lubrication records.

4. Electrical and instrumentation test results as required in Division 16.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01770

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements Included:

1. Close Out Procedures.
2. Final Cleaning.
3. Project Record Documents.
4. Systems Demonstration.

1.02 REFERENCED SECTION

A. The following Section is referenced in this Section:

1. Section 01750 – Testing, Training, and Facility Start-Up

1.03 CLOSEOUT PROCEDURES

A. When Contractor considers Work has reached final completion and **after all punch list items have been completed to the satisfaction of the Engineer**, submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for the Engineer's inspection.

B. In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.

C. The Engineer will issue a final Change Order reflecting approved adjustments to Contract Sum not previously made by Change Order.

1.04 FINAL CLEANING

A. Execute prior to final inspection.

B. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces. Clean equipment and fixtures to a sanitary condition, clean or replace filters on mechanical equipment. Clean roofs, gutters, downspouts, and drainage systems. Vacuum inside switchgear.

C. Clean site; sweep paved areas, rake clean other surfaces.

D. Remove waste and surplus materials, rubbish, and construction facilities from the Project and from the site.

1.05 PROJECT RECORD DOCUMENTS

A. Store documents separate from those used for construction.

B. Keep documents current; do not permanently conceal any work until required information has been recorded.

C. At Contract closeout, submit documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

1.06 SYSTEMS DEMONSTRATION

A. Prior to final inspection, demonstrate operation of each system to Engineer and City's maintenance staff and instruct City's personnel in operation, adjustment and maintenance of equipment and systems, using the operation and maintenance data as the basis of instruction in accordance with Section 01750.

1.07 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, and maintenance materials in quantities specified in each section, in addition to that required for completion of Work including a full set of replacement fuses for all electrical equipment. Coordinate with City, deliver to Project site and obtain receipt prior to final payment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 PUNCH LIST

A. Contractor shall complete all punch list items prior to completing the work identified herein in Contact Closeout.

END OF SECTION

SECTION 01780

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the format and content of operation and maintenance manuals along with the instruction to City's personnel.

1.02 REFERENCES

A. Section 01330 – Submittals

B. Section 01770 – Contract Closeout

C. Individual Specifications Sections: Specific requirements for operation and maintenance data.

1.03 QUALITY ASSURANCE

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

1.04 HARD COPY FORMAT

A. Prepare data in the form of an instructional manual.

B. Binders: Commercial quality, 8-1/2 x 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. Correlate data into related consistent groupings for each binder.

C. Documentation included shall be clear and legible.

D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of project; identify volume number for multiple volume references.

E. Provide tabbed indexed for each separate product and system, with typed description of product and major component parts of equipment.

F. Text: Manufacturer's printed data, or typewritten data on 24 pound paper.

G. Drawings: Provide reinforcement of bound edge. Bind in with text; fold larger drawings neatly to size of text pages. Preferably no drawings larger than 11" x 17" unless approved by the Construction Manager. Drawings larger than 11" x 17" shall be inserted into pockets.

H. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, in four parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Product Engineer, Contractor, Subcontractors, and major equipment suppliers.

2. Part 2: Operation and maintenance instructions arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors, supplies and parts distributor. Identify the following:

   a. Significant design criteria.
   b. List of equipment.
   c. Parts list for each component.
   d. Operating instructions.
   e. Maintenance instructions for equipment and systems.
   f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:

   a. Shop drawings and product data.
   b. Certificates.
   c. Photocopies of warranties.

4. Part 4: Design Data.

1.05 INSTRUCTION OF CITY PERSONNEL

A. Before final inspection, instruct City' designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

1.06 SUBMITTAL OF OPERATION AND MAINTENANCE DATA

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before 25% of work is completed.

B. Submit one copy of completed volumes 14 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Engineer's comments. Revise content of all document sets as required prior to final submission.

C. Submit four sets of revised final volumes in final form within 14 days after final inspection.

1.07 ELECTRONIC SUBMITTALS

A. Each USB compatible flash drive should be clearly marked to identify the contents on the drive.

B. Submit two (2) USB compatible flash drive containing all Contractor generated electronic documents contained in the final volumes (drawings, text, etc.). Files shall be in the AutoCAD and Microsoft Office file format so as to be editable.

C. Submit two (2) USB compatible flash drives containing the final instructional manual in an Adobe PDF format as described in Subsection 1.04.

END OF SECTION

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SECTION 01781

WARRANTIES AND BONDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Preparation and submittal of warranties and bonds.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

1. Section 01330 – Submittals

1.03 FORM OF SUBMITTALS

A. Comply with Section 01330.

B. Bind in commercial quality 8-1/2 x 11-inch three-ring side binders, with hardback, cleanable, plastic covers.

C. Label cover of each binder with typed or printed title "WARRANTIES AND BONDS", with title of Project; name, address and telephone number of Contractor; and name of responsible principal.

D. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of Product or work item.

E. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

1.04 PREPARATION OF SUBMITTALS

A. Obtain warranties and bonds, executed in duplicate by responsible subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

1.05 TIME OF SUBMITTALS

A. Make submittals within ten days after Date of Completion, prior to final Application for Payment.

B. For items of Work when acceptance is delayed beyond Date of Completion, submit within ten days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 DURATION OF WARRANTIES

A. Warranties for construction shall be for a period of one year, unless otherwise specified.

B. Warranties for equipment shall be for a period of two years, unless otherwise specified.

END OF SECTION

SECTION 01900

SEISMIC REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. This Section is applicable to the following secondary structural system elements, non-structural components, and/or equipment:

1. Mechanical, electrical, and plumbing equipment and appurtenances
2. Generator
3. Conduit, piping, and similar systems
4. Chlorine Cylinders
5. Fluoride Saturator Tank
6. Storage racks, suspended ceilings, light fixtures, louvers, architectural features and other non-structural components

B. This Section does not apply to the following primary structures:

1. Control Building – See structural drawings
2. Concrete Tank – See Section 03370

1.02 REFERENCES

A. American Society of Civil Engineers Standard ASCE 7-10, Minimum Design Loads for Buildings and Other Structures, Chapters 11, 13, 15.

B. California Building Code, 2007 Edition.

1.03 DEFINITIONS

A. Engineer: The Engineer responsible for the preparation of Contract Documents.

B. Specialty Engineer: Structural or Civil Engineer provided by the contractor licensed in the State of California responsible for specific elements of the primary structural system, the secondary structural system, non-structural elements and/or equipment supported by structures.

1.04 GENERAL DESIGN REQUIREMENTS

A. The Contractor is responsible for producing designs that resist the total seismic forces in accordance with the seismic design criteria. The Contractor is responsible for coordinating between the Engineer and the Specialty Engineer.

B. The seismic design for non-structural components and equipment shall be in accordance with the IBC Chapter 16, and the required coefficients and factors for determining the total design seismic forces are provided for in the geotechnical report that is in Appendices.

C. Coordinate the layout so that adequate space is provided between items for relative motion. Provide additional supports and restraints between items of different systems when necessary to prevent seismic impacts or interaction.

D. Design anchorages of all elements of structures, non-structural components, equipment supported by structures, and non-building structures to resist static and dynamic operational loads, plus total seismic loads specified in the IBC, ASCE 7-10 Section 13.3.1. For anchorage uplift, multiply dead load by 0.9 and subtract 0.2SDS if used to reduce vertical seismic effects.

E. Design anchorages utilizing a Component Coefficient, Rp =1.5, unless supporting documentation for embedment length, showing compliance with section 13.4.2 of ASCE 7, is provided for expansion anchor bolts, chemical anchors, or cast-in-place anchors.

1.05 DESIGN REQUIREMENTS FOR PIPING AND CONDUITS

A. The Contractor is responsible for producing designs for support of piping, conduit, duct or other systems to resist total seismic forces based on the seismic design criteria coefficients specified above unless shown on the Contract Documents. Except where the technical specifications give specific exemption from resistance of seismic forces, all supports shall be designed to meet seismic criteria.

B. Where possible, pipes, conduit, and their connections shall be constructed of ductile materials (e.g., copper, ductile iron, steel or aluminum and brazed, welded or screwed connections). Pipes, conduits and their connections, constructed of non-ductile materials (e.g., cast iron, no-hub pipe and plastic), shall have the brace spacing reduced to one-half of the spacing allowed for ductile material.

C. Seismic restraints may be omitted for the following conditions, where flexible connections are provided between components and the associated piping and conduit:

1. All other exposed piping less than 2.5-inches inside diameter or electrical conduit less than 2.5-inches trade size.

D. As an alternative to designing the supports and anchorage, where an approved national standard provides a basis for the earthquake-resistant design, submit standard, data, and details for piping, conduit, duct or other systems:

1. For mechanical piping, process piping and electrical conduits, follow Guidelines for Seismic Restraints of Mechanical Systems by SMACNA modified as follows:

a. Seismically brace piping regardless of size or location. Provide transverse braces at all changes in direction and at the end of all pipe runs. Space transverse braces not more than 20 feet apart. Provide longitudinal braces at 40-foot centers.

1.06 SUBMITTALS

A. Submit in accordance with Section 01330.

B. Submit certification for equipment not listed in this specification but included in the contract documents that the equipment itself is designed to resist all internal seismic forces based on the seismic design criteria for the project.

C. Where required in the equipment specifications in or listed below, submit signed and sealed structural calculations and detailed drawings from a Specialty Engineer where the project is being built for the attachments and anchorage to the primary structure.

1. Required anchorage items include:
2. Chlorine gas cylinders
3. Fluoride saturation tank and feed system
4. Electrical switchgear, panels and equipment in electrical room

D. Structural calculations and detailed drawings shall be prepared by a Specialty Engineer.

E. Structural calculations and detailed drawings shall clearly show the total design seismic forces which will be transferred from the elements of the structural system, non-structural components, and/or equipment and their attachments to the prime structure.

1.07 QUALITY ASSURANCE

A. The Contractor is responsible for submitting signed and sealed structural calculations and detailed drawings from a Specialty Engineer

B. Comply with the California adopted and amended versions of the International Building Code (IBC) Section 1613, the referenced sections of ASCE 7.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

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SECTION 02160

SITE PREPARATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The work covered by this section consists of furnishing all labor, equipment and material necessary to perform surface preparation including clearing, grubbing, surface restoration, and disposal of debris.

B. Locations of underground facilities and utility tie-ins by exploratory excavations.

C. Contractor shall develop its primary access, works, and storage areas as indicated on the Drawings. Contractor shall provide safe access to adjacent property, facilities, and buildings at all times. Roadways and passageways shall not be obstructed.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 02200 – Earthwork

PART 2 - PRODUCTS

2.01 PROTECTIVE BARRIERS

A. Type: Heavyweight, high visibility, flat laminar mesh design.

B. Material: High-density polyethylene. Height: 60 inches.

C. Posts: Wood or metal posts at 10-foot spacing. Secure fence to posts with plastic cable ties.

PART 3 - EXECUTION

3.01 EXISTING FACILITIES

A. Contractor shall review the drawings, maps, and other resources for the existing facilities at the Site to determine and mark the approximate locations of underground facilities. Locations of underground facilities within the work area shall be determined by exploratory excavations prior to any excavations or construction traffic in the affected areas.

B. Prior to clearing, Contractor shall make an inspection with City Representative to determine the baseline condition of existing structures and other facilities adjacent to the items designated for removal. Contractor shall not proceed with operations until after the inspection has been completed and the City Representative has authorized Contractor to proceed.

C. Site preparation shall not damage structures or other improvements adjacent to the areas designated for site preparation. The Contractor shall repair or replace any damaged property.

D. Public utility agencies that are owners of underground utilities at the Site shall be contacted and coordinated with by Contractor to have the utilities located and marked prior to construction activities in the affected areas. Following the marking by the utility agencies, the location of each underground utility shall be determined by exploratory excavations prior to any excavations in the affected areas.

E. The approximate location of known utilities is shown on the Plans. Contractor shall verify the location of existing utilities in advance of construction to avoid project delays. Notify the Engineer of any utilities not shown on the Plans.

F. Existing utilities and tie-ins are assumed to be accurate to within one-foot (plus or minus) vertical and five feet (plus or minus) horizontal position. No additional compensation will be made for utilities and tie-ins within that accuracy.

G. Contractor shall protect all underground utilities and other improvements which may be impaired during construction operations. Contractor shall take all possible precautions for the protection of unforeseen utility lines to provide for uninterrupted service and to provide such special protection as may be necessary.

H. Prior to any excavation in the vicinity of any existing underground utilities, Contractor shall notify the respective authorities representing the City or agencies responsible for such facilities not less than three (3) days prior to excavation such that said City or agencies can be present during excavation work if they so desire.

I. Nothing herein shall be deemed to require the City to indicate the presence of existing service laterals or appurtenances when the presence of such utilities on the site of the construction project can be inferred from the presence of other visible facilities, such as buildings, meter and junction boxes, on or adjacent to the site of construction; provided, however, nothing herein shall relieve the City from identifying main or trunk lines on the Plans.

3.02 SAFETY AND PROTECTIVE BARRIERS

A. Contractor shall install appropriate barriers such as temporary fencing, sound barriers, berms, or concrete traffic barriers to protect workers, visitors, plant operations, and existing facilities from damage and disturbance.

B. Protective concrete slabs or encasements shall be provided for existing underground facilities that may be damaged by Contractor's equipment and vehicles.

3.03 CLEARING AND GRUBBING

A. All construction areas shall be cleared and grubbed of vegetation, debris, rubbish, and excess material to a depth of at least six inches and cleared of structures, pavements, fences, concrete and masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable materials of any kind which would interfere with the performance or completion of the Work, create a hazard to safety, or impair the Work's subsequent usefulness or obstruct its operation.

B. Protection: Care shall be exercised to confine such work to the work area. The Contractor shall take the necessary steps and use the necessary equipment to

adequately protect adjacent structures and properties from any damage. The physical means and methods used for protection are at the Contractor's option.

C. Following clearing of the Site, Contractor shall allow a period of at least three working days for Engineer's review for presence of unsuitable materials. Where indicated or ordered, soil identified as unsuitable by Engineer shall be over-excavated and either removed from the site or incorporated into fill as required in Section 02200. When such over-excavation is indicated, both overexcavation and subsequent backfill to the required grade shall be performed by Contractor. When such over-excavation is not indicated but is ordered by Engineer, such over-excavation and any resulting backfill will be paid for in accordance with a negotiated price.

3.04 ENVIRONMENTAL CONTROLS

A. Contractor shall minimize the generation of dust and other airborne particles.

B. Water shall not be used in a manner that creates dangerous or objectionable conditions such as flooding, erosion, overspray, or sedimentation in nearby ditches or streams.

C. If contaminated soils or any other hazardous materials are encountered, the affected clearing work shall be stopped and City Representative notified promptly.

D. Worker Protection: The Contractor is responsible for the health and wellbeing of its workers during the execution of this Contract. The work shall be conducted in accordance with all applicable local, state, and federal regulation, including 29 CFR § 1926.62. Any liability for working with residual and hazardous waste is solely the Contractor's responsibility.

E. Explosives and Burning: Not permitted in performance of Work.

3.05 DISPOSAL OF MATERIALS

A. All vegetation, debris, rubbish, and excess material removed during clearing and grubbing work shall become the property of the Contractor and shall be removed from the project site at the Contractor's cost. Contractor shall make his own arrangements for disposing of these materials outside the project site and he shall pay all costs involved. Arrangements shall include, but not be limited to, entering into agreements with property owners and obtaining necessary permits, licenses, and environmental clearances.

B. Debris, rubbish, vegetation, and excess material resulting from the clearing and grubbing process shall be removed from the site in a manner that will prevent spillage on streets or adjacent areas. Spillage shall be removed from streets and adjacent areas. Federal, State, and local hauling disposal regulations shall be complied with. Cleanup shall be an on-going activity throughout the contract period.

END OF SECTION

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SECTION 02200

EARTHWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Perform all earthwork, including grading, excavation, backfilling and compaction necessary or required for the construction of the work as covered by these specifications and indicated on the Drawings. The excavation shall include, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions that would interfere with the proper construction and completion of the required work.

B. Access to the site will be over public roads. Exercise care in the use of such roads and repair any damage thereto caused by construction operations. Such repair shall be to the satisfaction of the Engineer.

C. Place barriers at each end of all excavations and at such places along excavations as may be necessary to warn all pedestrian and vehicular traffic of such excavations. Place lights along excavations (from sunset each day to sunrise of the next day) until such excavation is entirely restored. Material for backfill or for protection of excavation from surface drainage shall be neatly placed and kept shaped so as to cause the least possible interference with public travel. Free access must be maintained to all fire hydrants, water valves and meters, and private driveways.

D. For periods of work suspension over two (2) days, trenches shall be completely backfilled.

E. The Contractor shall assume all responsibility for dust control and shall carry out proper and efficient measures whenever dust control is necessary.

F. Refer to Section 02911 of these Technical Specifications for grading and soil preparation in landscape areas.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 02911 – Landscape Soil Preparation

1.03 QUALITY ASSURANCE

A. Source Quality Control: Test reports shall be performed by an independent testing laboratory having three years minimum experience in testing soil materials to prove materials conform to requirements specified herein. All reports prepared by the testing laboratory shall be signed by a professional engineer registered to practice as a civil engineer in the State of California. All compaction tests shall conform to ASTM D 1557 Method A or C for laboratory tests. The Contractor shall pay testing costs for source quality control.

B. Compaction tests shall conform to ASTM D 1556 for field tests. Field tests by nuclear methods conforming to ASTM D 2922 may be used. Field tests conducted to assure compliance with the compaction requirements of this Specification shall be paid for by the City, except the costs of retests caused by the Contractor's initial inadequate installation effort, which will be back-charged to the Contractor.

C. Excavation and Backfill Allowable Tolerances:

1. Finish Subgrade Under Slab on Grade: Within plus 0 to minus 0.10-foot of theoretical line-and-grade.

2. Excavated Surface Under Spread Footings: Within plus 0 to minus 0.05-foot of required grade.

3. Finish Subgrade Below Topsoil and finish Grade Without Topsoil in Planted Areas: Within ±0.25-foot of theoretical line-and-grade.

4. Finish Subgrade Under Paved Areas: Within plus 0 to minus 0.10-foot at theoretical grade.

5. Finish Subgrade Under Structures: Extend a minimum of 5-feet 0-inches beyond exterior line of building.

6. Finish Subgrade Under Pavement: Extend a minimum of 1-foot 0-inches beyond edge of pavement or curb.

7. Finish Subgrade Under Pavement: Surface deviation less than 1/2-inch when tested with a 6-foot straight edge applied both parallel and at right angles to the centerline of the area.

D. Monitoring Program

1. A monitoring program shall be established to evaluate total and differential settlement during the initial loading and for six months thereafter.

2. The monitoring program shall include at least 6 survey points for the water storage tank and 4 survey points for the backwash recycle tank established along the perimeter of the tanks.

3. The Geotechnical Engineer will evaluate the results after each survey reading.

1.04 SUBMITTALS

A. The below listed sheeting & shoring plan, samples, and test reports shall be furnished under the product data category of shop drawings.

B. Sheeting and Shoring Plan:

1. The attention of the Contractor is directed to Section 6705 of the Labor Code of the State of California.

2. The Contractor is required to submit a detailed plan showing the design of shoring, bracing, sloping or other provisions for worker protection from the hazard of caving ground during the excavation of any trench or trenches five feet or more in depth.

3. A plan conforming to the requirements of Section 6705 of the Labor Code shall be submitted by the Contractor. If such plan varies from the shoring system standards established by the Construction Safety Orders of the Division of Industrial Safety of the State of California, the plan shall be prepared by a registered Civil or Structural Engineer of the State of California.

4. Nothing in this requirement shall be deemed to allow the use of shoring, sloping or protective system less effective than that required by the Construction Safety Orders. Nothing in this requirement shall be construed to impose tort liability on the City, or any of its representatives.

C. Samples:

1. Furnish, without additional cost to the City, such quantities of construction materials as may be required by the Engineer for test purposes.

2. The Contractor shall cooperate with the Engineer and furnish necessary facilities for sampling and testing of all materials and workmanship.

3. All material furnished and all work performed shall be subject to rigid inspection in the field by the Engineer.

D. Test Reports:

1. Submit test reports on proposed imported material prior to delivery to the site.

1.05 EXPLOSIVES

A. The use of explosives will not be allowed.

1.06 SUBSURFACE INVESTIGATIONS

A. Geotechnical investigations for design purposes were made by the City of Sacramento.

B. The geotechnical report covering the investigative work is attached in the Appendix. While the records of data obtained may be considered by the Contractor to be correct, any conclusions or recommendations made in the reports are for information to the Engineer and are not a part of the Contract Documents.

C. The bidders may make additional subsurface investigations at the site prior to the bidding of the project. Prior to making any drilling or excavations, the bidder shall secure permission from the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide and install materials as shown on the Drawings and as specified herein.

B. Pipe Bedding and Initial Backfill:

1. The granular material for pipe bedding and initial backfill shall consist of "Bedding Sand" meet the requirements of the City of Sacramento's Standard Specifications, Section 10-13.

2. Bedding Sand shall have a minimum sand equivalent of 50. Ninety to one hundred percent (90-100%) shall pass the #4 sieve and a maximum of fifteen percent (15%) shall pass the #200 sieve.

3. Sand material shall be of a good quality with a minimum resistivity of 5,000 ohm-cm, a minimum pH of 6.0, a maximum chloride concentration of 300 ppm, and a maximum sulfate concentration of 1,000 ppm.

C. Trench Backfill:

1. Except as noted on the Drawings, trench backfill shall consist of material excavated from the trench.

2. Material for trench backfill shall be free of rocks or lumps larger than three (3) inches in size and shall not contain excessive amounts of clay, organic matter, and debris.

D. Class 2 Aggregate Base:

1. Class 2 aggregate base shall conform to the applicable requirements in Section 10-7 of the City Standard Specification, except payment provisions shall not apply.

2. The combined aggregate shall conform to the grading specified for the three-quarter inch (¾") maximum aggregate for Class 2 aggregate base.

E. Permeable Aggregate Base (Permeable AB):

1. Permeable AB shall be Class I – Type per the State Standard Section 68-2.02F(2) and shall conform to the following gradation:

Sieve Size	Percent Passing by Weight
3/4”	100
1/2”	95-100
3/8”	70-100
No. 4	0 – 55
No. 8	0 – 10
No. 200	0 – 3

2. No recycled material shall be allowed.

F. Structural Fill:

1. Material shall be free from debris, roots, wood, scrap material, vegetable matter, rocks over 3-inches in greatest dimension or other deleterious substances.

2. The import material shall have a plasticity index of at least 15 and shall be capable of being compacted to a relative density of 90 percent.

3. The material shall be favorably reviewed by the Engineer prior to placement.

G. Non-Expansive Fill:

1. All import fill or soils used for non-expansive fill shall be nearly free of organic or other deleterious debris, essentially non-plastic, and less than 3 inches in maximum dimension.

2. In general, well-graded mixtures of gravel, sand, non-plastic silt, and small quantities of cobbles, rock fragments, and/or clay are acceptable for use as import and non-expansive fill.

3. All fill materials to be used for structural fill shall be sampled and tested by a City representative prior to being transported to the site.

H. Specific requirements for import and non-expansive fill are provided below:

Sieve Size	Percent Passing (ASTM C136)
3-inch	100
No. 4	50 – 100
No. 200	15 – 70

I. Liquid Limit:

1. Less than 30; Plasticity Index: Less than 12 (ASTM D4318); and Organic Content: Less than 3 percent (ASTM D2974).

J. Crushed Screenings:

1. Crushed screenings shall conform to the requirements for coarse (½" x No. 4) crushed screenings as set forth in the City of Sacramento's Standard Specifications: Section 10-14.

K. Water:

1. The water used shall be reasonably free of objectionable quantities of silt, oil, organic matter, alkali, salts and other impurities.

2. Water quality must be acceptable to the Engineer.

L. Control Density Fill (CDF):

1. Also known as Controlled Low Strength Material (CLSM) or ready Mixed Flowable Fill (RFF) as processed and distributed by the National ready Mixed Concrete Association.

2. CDF shall conform to the applicable requirements in Section 10-16 of the City Standard Specification.

3. Material shall be a hand excavatable mixture of cement, pozzolan, course and fine aggregate and water which has been mixed in accordance with ASTM C 94.

4. Minimum density shall be 120 PCF, maximum density 135 PCF.

5. The minimum 28 day compressive strength shall be 50 psi and the maximum shall be 150 psi.

M. Slurry Cement Backfill for use as trench backfill shall conform to the requirements of Section 19-3.062 of the State Specifications except that no less than 282 pounds of cement shall be used for each cubic yard of material produced

PART 3 - EXECUTION

3.01 CONTROL OF WATER

A. All excavations shall be kept free from water and all construction shall be in the dry. Groundwater shall be maintained either naturally or by dewatering at least three feet below the lowest anticipated excavation depth.

B. The Contractor shall be responsible for furnishing temporary drainage facilities to convey and dispose of surface water falling on or passing over the site.

3.02 EXISTING UTILITIES

A. General:

1. The known existing live and abandoned utilities are shown on the Drawings in their approximate location.
2. The Contractor shall exercise care in avoiding damage to live facilities as he will be held responsible for their repair if damaged.
3. There is no guarantee that all utilities or obstructions are shown, or that locations indicated are accurate.
4. Utilities are piping, conduits, wire, cable, poles, ducts, manholes, pull boxes and the like, located at the project site and adjoining said site.

B. Overhead Facilities: There are existing overhead electric and telephone transmission lines along the project site. These overhead utilities are not all shown on the Drawings.

C. Extreme caution shall be used when working in the vicinity of overhead utilities so as to prevent injury to workmen or damage to the utilities.

D. Prior to beginning any work the Contractor shall contact Underground Service Alert at (800) 227-2600.

3.03 TRENCH EXCAVATION, PIPE BEDDING, AND INITIAL BACKFILL

A. Trench Excavation

1. Trenches for piping shall be excavated to the lines and grades indicated on the Drawings. Excavated material shall not be placed closer than one (1) foot from the edge of the trench.

B. Trench Bottom

1. The bottom of the excavated trench shall be cleared of rocks and clay lumps larger than two (2) inches in size. All grade stakes, wood, or other organic material shall be removed from the trench. The bottom of the trench shall be smoothed and compacted to provide uniform support for the bedding and pipe at every point between the joints. The bottom of the

trench shall be compacted to a minimum of 85 percent of maximum dry density as determined by ASTM Test Designation D698.

2. Where the excavated trench bottom is soft, unstable soils unsuitable for the support of the pipe bedding material, the unsuitable soil material shall be removed and replaced with imported crushed screenings material. The depth and method of removal and replacement of unsuitable material shall be as directed by the Engineer or authorized representative.

C. Pipe Bedding and Initial Backfill

1. Granular bedding material (Bedding Sand) shall be placed and compacted along the bottom of the trench to provide uniform support for the water transmission main pipe at every point between the joints. The granular bedding material shall be placed to a width of at least one-half of the outside diameter of the pipe. Support of the pipe by wedging or blocking shall not be permitted. At the location of each joint, holes of adequate size shall be provided in the bottom and sides of the trench to permit easy joint preparation, pipe assembly and visual inspection of the entire joint.

2. After placement and compaction of the granular bedding material, pipe shall be carefully lowered into place and adjusted to the required line and grade. Where it becomes necessary for the pipe to be deflected at the joints in a horizontal or vertical direction either to avoid obstructions or where large radius curves are permitted, the degree of joint deflection degree shall be limited to two-thirds (2/3) of the value recommended by the manufacturer of the pipe.

3. Initial backfill shall be the granular material placed and compacted around the pipe from the top of the bedding material to a minimum depth of eight (8) inches over the top of pipe. The initial backfill material shall be placed in even lifts along both sides of the pipe and compacted in a manner that will provide firm and uniform support for the haunches of the pipe.

4. Consolidation and compaction of the initial backfill material around and over the top of the pipe may be performed by shovel slicing, tamping, or vibratory methods. Water jetting methods of compaction shall not be permitted. The Contractor shall exercise caution in placing and compacting the initial backfill material so as not to dislodge the pipe from planned line and grade.

5. The granular material for pipe bedding and initial backfill shall consist of either "River Sand" or three-eights (3/8) inch clean crushed rock. When crushed rock is used as pipe bedding material, sand shall not be used for initial backfill. Granular bedding and initial backfill material, whether sand or crushed rock, shall be compacted to 90 percent of maximum dry density as determined by ASTM Test Designation D698.

D. Trench Shoring, Sheeting, and Bracing

1. The Contractor shall furnish, install, and maintain a trench or shoring system in compliance with the requirements set forth in the City's Standard Specifications.

3.04 TRENCH BACKFILL

A. Trench backfill shall be earth material placed and compacted above the granular bedding and initial backfill material to the level of the subgrade in paved areas or to the top of the trench in unpaved areas. The top 12 inches of backfill in trenches located within the shoulder area of existing streets and under pavement shall be Class 2 aggregate base meeting the requirements of the City of Sacramento Standard Specifications. Placement and compaction of trench backfill material shall meet the applicable requirements of the City of Sacramento's Standard Specifications and the Drawings.

B. Care shall be exercised in backfilling trenches to avoid damage or displacement of the pipe. Under no circumstances shall sharp, heavy pieces of material be allowed to drop directly onto the pipe or the compacted material around the pipe. Backfill shall not be pushed into the trench in a way such as to permit free fall of the material until at least 2 feet of cover is provided over the top of the pipe.

C. Trench backfill material shall be compacted to a minimum dry-density of 90 percent, as determined by ASTM Test Designation D1557 in accordance with the requirements of the City of Sacramento's Standard Specifications. In paved areas, the upper twelve (12) inches below subgrade shall be compacted to a minimum dry density of 95 percent, as determined by ASTM D1557.

D. Trench excavation material may require processing (discing, blending, moistening, drying, etc.) in order to attain the gradation and/or moisture content necessary to meet the compaction requirements.

E. No material shall be used for trench backfill which, because of excessive moisture, excessive clay content, or any other reason, cannot be compacted to the degree specified. Any such material shall be considered unsuitable and shall be disposed of outside the limits of the project.

3.05 FULL DEPTH SELECT OR IMPORTED BACKFILL

A. Full depth select or imported backfill shall be provided as directed the Engineer or authorized representative. Full depth select backfill shall be placed as indicated in the Drawings and Special Provisions. Full depth select backfill material shall consist of Class 2 aggregate base meeting the requirements of the City of Sacramento's Standard Specifications or slurry cement backfill meeting the requirements of these Special Provisions.

B. Full depth select backfill may be required under the following circumstances:

1. In streets where it is desired to reopen the affected construction area to traffic in as short a time as possible.
2. At locations where over excavation is required, i.e., under butterfly valves, blow-offs, system tie-in connections, insulated joints, etc.
3. At locations where pipes for sewer or drain lines cross above a water pipe.
4. In areas where the trench section is of unusual configuration.

C. Full depth select backfill shall extend to the level of subgrade road subbase and to undisturbed earth on the sides.

3.06 EXCAVATION FOR STRUCTURES

A. All excavation for structures shall be done to the dimensions and levels necessary to provide the subgrade indicated on the Drawings or specified herein. Excavation shall be made to such width outside the lines of the structure to be constructed as may be required for proper working methods, the erection of forms and the protection of the work.

B. Overexcavation: Care shall be taken to preserve the foundation surfaces shown on the Drawings in an undisturbed condition. If the Contractor overexcavates or disturbs the foundation surfaces shown on the Drawings or specified herein, without written authorization of the Engineer, he shall replace such foundations with concrete fill or structural fill material as directed by the Engineer in a manner which will show by test an equal bearing value with the undisturbed foundation material. No additional payment will be made for the added quantity of concrete fill or other material used because of overexcavation.

C. Inspection of Excavation: The Contractor shall notify the Engineer when excavation for compaction fill or structure is complete, and no forms, reinforcing steel or concrete shall be placed until the excavation has been inspected by the Engineer.

D. If the Contractor wishes to stockpile excavated material, he shall provide adequate facilities for drainage of water from the material and adequate facilities for handling of storm drainage from the area.

E. Where unsuitable material is encountered below the grades shown, for structural excavations, it shall be removed and replaced and compacted with structural fill material as directed by the Engineer. The Contractor shall be entitled to compensation per provisions of the Standard Specifications.

3.07 SUBGRADE AND COMPACTION FOR STRUCTURES - GENERAL

A. Subgrade Preparation: All native subgrade soils that will receive structural fill, non-expansive fill or aggregate base or otherwise support structures shall be scarified or ripped to a minimum depth of 12 inches below the finished subgrade elevation and uniformly moisture conditioned to a moisture content ranging from 2 to 5 percentage points above the optimum moisture content.

B. Equipment Pads: In the proposed backwash recycle tank, equipment pad and building areas, the subgrade soils shall be compacted to at least 90 percent relative compaction and not greater than 95 percent of the maximum dry density (relative compaction) as determined by ASTM Test Method D 1557.

C. Additional Subgrade Preparation: The subgrade soil shall be in a stable, non-pumping condition at the time fill or aggregate base materials are placed and compacted. At the direction of the Engineer, overexcavation of disturbed soil, scarification and compaction of the exposed subgrade, and replacement with structural fill will be required to sufficiently densify all disturbed soil.

D. Prior to placing steel or concrete, foundation excavations shall be cleaned of all debris, loose or soft soil, and water. If shrinkage cracks appear in the foundation excavations, the excavations shall be thoroughly moistened to close all cracks prior to placement of concrete. All foundation excavations shall be observed by the project Geotechnical Engineer or a designated representative prior to placing

steel or concrete to confirm that the recommendations contained herein are implemented during construction.

E. Non-Expansive Fill: At least 18 inches of non-expansive fill shall be placed directly below all structures. The zone of non-expansive soil shall extend laterally at least 3 feet outside the perimeter of the structures. the fill soils shall be compacted to at least 90 percent relative compaction and not greater than 95 percent of the maximum dry density (relative compaction) as determined by ASTM Test Method D 1557. The moisture content of the soils shall be maintained until placement of the fill or aggregate base by liberal sprinkling with water or other suitable method.

F. Structure Backfill: Backfill shall not be placed against structures until the concrete has been patched and cured, until at least 28 days after the concrete was placed, or until the concrete has achieved a strength of at least 3,200 psi, whichever is earlier. Place backfill in uniform, level layers, not exceeding 8 inches thick measured before compaction. Bring backfill up uniformly on all sides of the structure, and on both sides of buried walls.

3.08 STRUCTURAL FILL

A. Structural fill composed of native or imported material shall be uniformly moisture conditioned to a moisture content ranging from 1 to 4 percentage points above the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent relative compaction.

B. Additional fill lifts shall not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. All trench backfill in building or other structural areas shall be placed and compacted in accordance with the recommendations provided above for structural fill.

C. At the time of compaction, the moisture content of all embedment and backfill materials shall be such that the specified compaction is obtained. Material which contains a moisture content from which the required compaction cannot be obtained shall not be compacted until it is brought to a moisture content that will permit proper compaction. Employ such means as may be necessary to secure uniform moisture content throughout the material of each layer being compacted. After the material has been moisture conditioned, it shall be compacted by compaction equipment favorably reviewed by the Engineer to achieve specified compaction.

D. Compaction of embedment and backfill materials by flooding, ponding or jetting shall not be permitted.

E. When densities of materials do not meet the requirements for compaction, remove and recompact the material until the requirements are met. The Contractor shall be backcharged the cost of retesting all failing tests.

3.09 BACKFILL AND COMPACTION FOR RESERVOIR

A. Subgrade Preparation: Following site clearing and stripping operations the excavation for the reservoir foundation shall be performed. The exposed subgrade soils shall be observed by the Engineer to verify the presence of clay (low permeability). The subgrade shall be scarified to at least 12 inches, moisture

conditioned to above the optimum moisture and compacted to at least 90 percent of ASTM D1557.

1. Compaction of the existing ground surface shall be performed using a heavy, self-propelled sheepsfoot compactor (Caterpillar 815 or equivalent) and shall be performed in the presence of the Engineer who will evaluate the performance of the subgrade under compactive load and identify any loose or unstable soil conditions that could require additional excavation.

2. Reservoir Foundation: Reservoir foundation above the ground improved subgrade shall be established with imported aggregate base material and drain rock placed in lifts not to exceed six inches in compacted thickness and uniformly compacted at or near the optimum moisture content. Each layer should be compacted to not less than 95 percent of the maximum dry density as determined by ASTM D 1557.

B. Backfill and Compaction: Native clay shall not be used for backfill directly against the concrete water tank wall or other structure. A wedge of non-expansive fill material shall extend from the bottom of the tank wall outward and upward at a slope of at least 1(h):1(v) or flatter.

1. Structural fill shall be placed in lifts that do not exceed six inches in maximum compacted thickness. Bench the lifts of fill into the existing excavation slopes for a horizontal distance of at least 18 inches.

2. Heavy equipment shall not be used for compaction of structural fill adjacent to the reservoir. Within the setback zone, only hand operated equipment ("whackers," vibratory plates, or pneumatic compactors) shall be used to compact the backfill soils.

3.10 SUPPORT OF EXCAVATION FOR TRENCHES AND STRUCTURES

A. Excavation for trenches and structures shall be adequately supported to meet all requirements in the current rules, orders and regulations prescribed OSHA. Excavation shall be adequately shored, braced and sheeted so that the earth will not slide or settle and so that all existing structures and all new pipe and structures will be fully protected from damage.

B. The support for excavation shall remain in place until the pipeline or structure has been completed. During the backfilling of the pipeline or structure, the shoring, sheeting and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement or flowing of the subsoils.

3.11 CRUSHED SCREENINGS UNDER STRUCTURES

A. Unless otherwise shown or noted, place a 12-inch layer of crushed screenings, compacted to 95 percent relative compaction, under structures to the lines, grades and minimum thicknesses shown on the Drawings.

3.12 SUBGRADE AND FILL FOR PAVED AREAS

A. Subgrade Preparation: All native subgrade soils that will receive structural fill, non-expansive fill or aggregate base or otherwise support pavement shall be scarified or ripped to a minimum depth of 12 inches below the finished subgrade elevation and uniformly moisture conditioned to a moisture content ranging from

2 to 5 percentage points above the optimum moisture content. The exposed subgrade soils shall be observed by the Engineer to verify the presence of clay (low permeability). The subgrade shall be scarified to at least 12 inches, moisture conditioned and compacted to at least 90 percent of ASTM D1557.

B. All fill soils, either native or imported, required to bring the site to final grade shall be compacted as structural fill. Discing and/or blending may be required to uniformly moisture condition soils used for structural fill. This operation shall include plowing, disking, and any moistening or aerating required to obtain proper compaction.

C. Subgrade for paved areas shall be shaped to line, grade and cross-section as shown and compacted as noted on the Drawings. Soft or otherwise unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory and suitable material.

D. Low areas resulting from removal of unsatisfactory material or excavation of rock shall be brought up to required grade with structural fill material, and the entire subgrade shall be shaped to line, grade, and cross-section and compacted as shown. The elevation of the finished subgrade shall conform to the elevations shown on the Drawings.

E. Finish grade the site to the finish elevations shown on the Drawings. Finish grading shall be uniform, pleasing, and provide drainage from all areas to collection points.

3.13 DISPOSAL OF EXCESS EXCAVATION MATERIAL

A. Excavation material in excess of that needed for fill shall be disposed of offsite or spread, compacted, and graded to drain within the limits of the soil stockpile area. No additional compensation will be paid for such disposal. All such costs shall be included in the Lump Sum Bid Proposal for the project.

END OF SECTION

SECTION 02215

TANK DRAINAGE FACILITIES AND WATERPROOFING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor furnished and installed drain pipe, water proofing, and prefabricated drainage composite for the tank underdrains and tank walls including all piping, fittings, and accessories as shown on the Plans, described in the Specifications and as required to completely cover, drain, and interconnect for a complete and operable system.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals
2. Section 02200 – Earthwork

1.03 SUBMITTALS

A. Submittals shall comply with Section 01330 and include the following:

1. Product Data: Submit manufacturer's product data certificates of compliance for drainage materials specified.
2. Shop Drawings: Submit shop drawings showing layout, profiles, and product components, including accessories for drainage composites.
3. Samples: Submit verification samples for prefabricated drainage composites.
4. Manufacturer's Warranty: Submit drainage composite manufacturer's standard two year drainage warranty document executed by authorized company official.
5. Drainage Composite Installer Qualifications: Submit installer qualifications experienced to perform work of this section, who has specialized in the installation of work similar to that required for this project, who can comply with manufacturer's warranty requirements, and who is an authorized applicator as determined by drainage manufacturer.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Schedule deliveries to avoid construction delays but minimize jobsite storage.

PART 2 - PRODUCTS

2.01 MATERIALS REQUIREMENTS

A. Drain Pipe

1. Tank drain pipe shall be Polyvinyl Chloride (PVC) pipe, Schedule 80, Class 12454-B, rigid, unplasticized pipe made from polyvinyl chloride in accordance with ASTM D1784 and D1785. Pipe joints shall be bell and spigot, pipe fittings shall be Schedule 40, of the same material as the pipe, conforming to ASTM D2466. Solvent weld connections shall be made in strict accordance with the pipe manufacturer's recommendations using a solvent cement and primer meeting ASTM D2564.

2. Perforated pipe shall have a water inlet area of 1.0 square inch per linear foot of pipe. Circular holes shall be cleanly cut not more than 3/8 inch or less than 3/16 inch in diameter arranged in rows parallel to the longitudinal axis of the pipe.

B. Permeable Material

1. Permeable material for drains shall be hard, durable, clean, crushed rock, in accordance with Section 02200.

C. Geotextile Filter Fabric

1. The geotextile shall be Mirafi 140 NC, as manufactured by the Nicolon Corporation, Tensar 3401, as manufactured by the Exxon Chemical Corporation, Supac 5 N/P, as manufactured by the Philips Fibers Corporation, or equal.

D. Waterproofing Material

1. Waterproofing material shall consist of Tnemec Series 27WB, Carboline Bitumastic 50, or equal.

E. Drainage Composite

1. Prefabricated Drainage Composite: MiraDRAIN 6200, or Amerdrain 520, a 3-dimensional dimpled polystyrene core and non-woven geotextile filter fabric, by Carlisle Corp. or American Wick Drain. Composite shall meet the following criteria:

Property	Test Method	Unit	Value
Core			
Thickness	ASTM D 1777	In	0.40
Compressive Strength	ASTM D 1621	psf	15,000
Maximum Flow Rate(1)	ASTM D 4716	Gpm/ft	17
Fabric			
Apparent Opening Size	ASTM D 4751	US Std Sieve	70
Water Flow Rate	ASTM D 4491	Gpm/ft 2	140
Grab Tensile Strength	ASTM D 4632	Lbs	100
Puncture Resistance	ASTM D 4833	Lbs	65

PART 3 - EXECUTION

3.01 WATER PROOFING

A. The tank exterior wall below finish grade shall be water proofed with two coats of Tnemec Series 27WB, Carboline Bitumastic, or equal. Apply the prefabricated drainage composite over the water proofing membrane. The concrete surface preparation and application of above material shall be in accordance with the recommendations of the manufacturer.

3.02 INSTALLATION OF GEOTEXTILE AND DRAINAGE PIPING

A. Geotextile

1. The geotextile shall be wrapped around the perforated drainage piping prior to installation with a minimum lap of 3 inches. The geotextile shall be rejected if it has defects, rips, holes, flaws, deterioration or damage incurred during manufacture, transportation or storage.

B. Drainage Piping

1. Drain pipe shall be laid to the line and grade indicated with a continuous fall in the direction of flow. Bell of pipe sections shall face upgrade. Interior of pipe shall be cleaned thoroughly before being laid. When drain lines are left open for connection to discharge line, the open ends shall be temporarily closed and the location marked with wooden stakes. Perforated pipe shall be laid with perforations facing down. Any length that has had its grade or joints disturbed shall be removed and re-laid at the Contractor's expense.

2. Perforated drain pipe shall be laid with closed joints

3. No backfill shall be placed until all joints and connections have been inspected and approved by the Engineer. When placing the backfill, care shall be taken to prevent displacement of, or injury to, the pipe and geotextile fabric.

4. Pipe ends shall be fitted with grated or slotted caps.

3.03 DRAINAGE COMPOSITE

A. Examination

1. Site Verification of Conditions: Verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions. Do not proceed with drainage installation until substrate conditions are acceptable for compliance with manufacturer's warranty requirements.

B. Vertical Surfaces

1. Completed Walls:

a. Position the panel with the flat side against the wall and filter fabric toward the soil/drainage side.

b. MiraSTICK contact adhesive shall be used to attach the panel against the concrete wall.

2. Connecting Adjacent Panels:

a. Connect adjacent panels at the longitudinal edge by pulling the filter back to expose the flange.

b. The panel edge should be butted to the edge of the adjacent panel dimple to dimple or the edge of the next panel may be placed over two dimples and interlocked.

c. Panel ends are to be attached in the same manner.

d. Connections should be completed in shingle fashion so that moisture will flow with the overlap and not against it.

e. Overlap fabric in the direction of water flow.

f. Cover all terminal edges with the filter fabric flap by tucking in behind the core.

C. Discharge Connections

1. Install QuickDRAIN prefabricated drainage collection system in a vertical foundation wall to a horizontal footing configuration.

2. Adhere QuickDRAIN to the substrate using MiraSTICK contact adhesive or MiraBOND tape.

3. Place the hinged portion of the QuickDRAIN against the vertical/horizontal transition and press into place. Connect adjacent panels by pulling filter fabric back to expose the flange.

4. Overlap the flange of the core of edge drain on to the flange of the preceding drain core.

5. Cover the joint with the filter fabric. Install Mira DRAIN in shingle fashion overlapping the flange of the QuickDRAIN in the direction of water flow and cover with filter fabric.

6. Cover all terminal edges of the core with the fabric flap by tucking it behind the core.

D. Terminal Connections and Protrusions:

1. Cover all terminal edges with the integral fabric flap by tucking it around the edge of the core and securing it.

2. At protrusions, cut the core around the protrusion, cut an ”X” in the fabric, and tape the fabric around the protrusion.

3. Dirt and concrete shall not infiltrate the core.

3.04 CLEANING AND PROTECTION

A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer’s instructions prior to City acceptance. Remove construction debris from project site and legally dispose of debris.

B. Protection: Protect installed finished surfaces from damage during construction

END OF SECTION

SECTION 02510

PAVING AND ROAD SURFACING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor furnished labor, materials, equipment, and incidentals necessary to construct all paving shown on the Drawings, and/or specified herein. The work shall include, but not necessarily be limited to, scarifying and preparing the subgrade, placing and compacting engineered fill materials, placing and compacting Class 2 aggregate base, applying paint binder, placing and compacting asphalt concrete, and all related work.

1.02 REFERENCED SECTIONS

A. The Following Sections are referenced in this Section

1. Section 01330 – Submittals
2. Section 02200 – Earthwork

1.03 SUBMITTALS

A. The following information shall be submitted in accordance with Section 01330.

1. Manufacturer's Data or Certificate of Compliance
   a. Aggregate base
   b. Prime coat and paint binder
   c. Asphalt concrete
   d. Slurry seal
   e. Independent test laboratory name
   f. Paint markings and reflective markers
2. A certificate of compliance signed by the manufacturer shall be furnished prior to the use of any asphalt materials. The certificate shall state that the material complies with the requirements of these Specifications. A certificate shall be furnished with each lot of material delivered to the site and the lot so certified shall be clearly identified in the certificate. Certificates of compliance shall be provided for each type of asphalt product used.

1.04 REFERENCE PUBLICATIONS

Reference	Title
State Standard Specifications	Standard Specifications, State of California Business, Transportation and Housing Agency, Department of Transportation, 2010
State Standard Plans	Standard Plans, State of California Business, Transportation and Housing Agency, Department of Transportation, 2010

Reference	Title
ASTM D2922	Density of Soil and Soil Aggregate in Place by Nuclear Methods
ASTM D3017	Moisture Content of Soil and Soil Aggregate Place by Nuclear Methods

PART 2 - PRODUCTS`

2.01 ENGINEERING FILL

A. Engineered fill shall be as specified in Section 02200.

2.02 CLASS 2 AGGREGATE BASE

A. Class 2 aggregate base shall meet all requirements of State Standard Specification Section 26 for ¾-inch maximum grading.

2.03 PAINT BINDER (TACK COAT)

A. The paint binder (tack coat) shall meet all the requirements of State Standard Specification Section 94. Tack Coat shall be RS-1 paving asphalt applied to vertical surfaces of existing pavement immediately prior to placement of new HMA.

2.04 ASPHALT SEAL COAT

A. Seal coats shall consist of asphalt emulsion, water, and aggregate of the quality and proportions as specified in the State Standard Specifications and Section 23 of the of the Sacramento Standard Specifications.

2.05 ASPHALT CONCRETE

A. Hot Mix Asphalt (HMA) shall meet the requirements of State Standard Specification Section 39-3 for Type A Hot Mix Asphalt construction process.

B. The asphalt to be mixed with the aggregate shall meet the section of State Standard Specification Section 92-1.02 for PG 64-10 Asphalt Binder.

C. 1/2" maximum, medium HMA using PG 64-10 for the top lift. All other lifts shall be Type A 3/4" maximum, medium HMA using PG 64-10.

2.06 TRAFFIC LINE PAINT AND MARKERS

A. Traffic line markers shall be thermoplastic markers and shall conform to the provisions markings in Section 84-1, “General”, Section 84-2, “Thermoplastic Traffic Stripes and Pavement Markings” of the Caltrans Specifications.

B. Traffic line paint shall be solvent borne type conforming to Caltrans 2010 Standards Section 84-3.02.

C. Pavement markers shall be ceramic round conforming to the provisions in Section 85, “Pavement Markers” of the Caltrans Specifications.

2.07 HEADER BOARD

A. A Header board shall be placed at all limits of paving not abutting a concrete structure. Header board shall consist of continuous pressure treated Douglas fir 2 x 6 attached to 18-inch pressure treated Douglas fir 2 x 4 stakes at 4 feet on center.

PART 3 - EXECUTION

3.01 GENERAL

A. Pavement shall be executed in accordance with the State Standard Specifications and Section 23 of the Sacramento Standard Specifications for placing asphalt concrete.

B. All lanes and the full width of the traveled way shall be open to all traffic when construction operations are not actively in progress. All traffic lanes shall be restored with temporary pavement at the end of the work day. Compact all areas within the roadway and shoulder. Provide temporary striping and markers as required.

C. Once excavation and other construction activities begin at a work site, all work including permanent pavement restoration, pavement overlay, and striping shall be completed at that site within 15 calendar days.

3.02 FINAL GRADING

A. The final grade of the asphalt concrete shall vary not more than 0.05 foot from the elevations indicated on the drawings, and shall conform to the requirements of State Standard Specification Section 39-6. All areas shall be graded to drain.

3.03 SCARIFYING AND COMPACTING

A. All the subgrade material underlying asphalt concrete surfacing shall be overexcavated and filled per Section 02200 and compacted to a relative compaction of not less than ninety five percent (95%).

3.04 IMPORTED FILL

A. Imported fill material under paved areas shall be placed and compacted to a relative compaction of not less than ninety-five percent (95%) to a depth of 12 inches in accordance with Section 02200.

3.05 CLASS 2 AGGREGATE BASE

A. Class 2 aggregate base shall be placed to a total depth of 12 inches. Placement, moisturizing, spreading, and compaction of Class 2 aggregate base shall meet all requirements of State Standard Specification Sections 26-1.03 through 26-1.05, State Standard Specification Section 17-1, and the details on the Drawings.

3.06 PAINT BINDER (TACK COAT)

A. After the sub-base and aggregate base are placed, compacted, and tested, to the satisfaction of the Engineer, tack coat shall be applied in accordance with State Standard Specification Section 39-1.09C.

3.07 ASPHALT CONCRETE

A. All loads of HMA shall be covered during transport and delivery from the plant to the paving machine.

B. Asphalt concrete shall be placed where indicated on the Drawings. Storing, proportioning, mixing, equipment, spreading, compacting, and miscellaneous

asphalt concrete shall conform to the requirements of State Standard Specification Sections 39-1.10 through 39-1.12, and State Standard Specification Section 22. Asphalt concrete shall be placed to a minimum thickness of 4 inches.

3.08 HEADER BOARD

A. A header board shall be placed at all limits of paving not abutting a concrete structure. Attached to 12-inch plastic stakes at three feet on center with metal screws.

3.09 TRENCH PAVEMENT RESTORATION

A. The pavement shall be cut back a minimum of 6 inches on each side of the trench or to the edge of pavement or concrete flatwork if it is within 3 feet of the trench section.

B. Existing pavements shall be cut on a line parallel to the trench so that a neat and vertical edge is left without causing damage to the adjacent pavement

C. Asphalt concrete shall be placed in lifts not to exceed 3 inches to restore the roadway to its original condition.

D. Bring the aggregate base material to a smooth, even grade at the correct distance below the top of the existing pavement surface so as to provide adequate space for the pavement. Trim existing pavement to a straight line to remove any pavement which has been damaged or which is broken and unsound to provide a smooth, sound edge for joining the new pavement.

E. Compact the subgrade to a minimum of 95 percent of maximum dry density as determined by ASTM D 1557 and as shown in Detail 0210 of the City Standard Details and accomplish supplementary compaction where required with approved mechanical vibrating or impact type tampers.

F. Place the asphalt concrete on the prepared subgrade over the trench to a depth as shown on the Plans. Place asphalt concrete after the prime coat has set. Spread and level the asphalt concrete with hand tools or by use of a mechanical spreader, depending upon the area to be paved. Bring the asphalt concrete to the proper grade and compact by rolling or the use of hand tampers where rolling is impossible or impractical.

G. Roll with power rollers capable of providing compression of 200 to 300 pounds per square inch. Begin the rolling from the outside edge of the replacement progressing toward the existing surfacing, lapping the existing surface at least 1/2 the width of the roller. If existing surfacing bounds both edges of the replacement, begin rolling at the edges of the replacement, lapping the existing surface at least 1/2 the width of the roller, and progress toward the center of the replacement area. Overlap each preceding track by at least 1/2 the width of the roller and make sufficient passes over the entire area to remove all roller marks and to produce the desired result, as determined by the Engineer.

H. The finished surface of the new compacted paving shall be flush with the existing surface and shall conform to the grade and crown of the adjacent pavement. Immediately after the new paving is compacted, all joints between new and original asphalt pavement shall be painted with hot asphalt or asphalt emulsion and be covered with dry paving sand before the asphalt solidifies.

I. Surface Smoothness: The surface smoothness of the replaced pavement shall be such that when a 12 foot straightedge is laid across the patched area between the edges of the old surfacing and the surface of the new pavement, the new pavement shall not deviate from the straightedge more than 1/4 inch. If the finished surface of the asphalt concrete does not meet the specified surface tolerances, it shall be brought within tolerance by either (1) abrasive grinding or (2) removal and replacement. The method will be selected by the Engineer and the corrective work shall be at the Contractor's expense.

3.10 TRAFFIC LINE PAINTING AND MARKERS

A. Pavement markings shall be replaced in their pre-construction configurations unless specified otherwise on the Plans. Stop bars shall be installed at all locations where stop signs exist. Stop limit lines shall be installed four (4) feet behind the extension of the curb faces of the intersecting street or before the ADA ramp, if one exists.

B. During pavement marking and marker placement removal and placement operations, traffic shall be controlled with lane closures in accordance with the approved Traffic Control Plan.

C. The Contractor shall notify the City a minimum of forty-eight (48) hours in advance of the layout and “cat-tracking” of all permanent markers and markings. Surfaces are to be free of contaminants that may interfere with adhesion. Thinning and coverage shall be as recommended by the manufacturer, but coverage shall not exceed 400 sf/gal. Traffic lines shall be of uniform width with the edges straight and even. Traffic shall be restricted from the area until the paint has dried.

D. No permanent markings shall be installed for seven (7) calendar days after the street has been surfaced, not including the day of application. This period of time has been established to allow the materials to cure. Permanent striping is to be installed between the eighth (8th) and thirteenth (13th) calendar days. Complete all permanent pavement marking work by the fourteenth (14th) calendar day following the placement of materials on each street.

3.11 TESTING

A. Perform laboratory and the initial field testing for density, moisture, and compaction of the asphalt base. Test laboratory shall provide written reports on the following test methods: Moisture, density, and compaction per ASTM D2922 and D3017.

END OF SECTION

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SECTION 02520

CONCRETE SIDEWALKS AND PAVEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes concrete sidewalks, driveways and pavement.

1.02 REFERENCES

A. The following Sections are referenced in this Section:

1. Section 01330 - Submittals
2. Section 02200 – Earthwork

B. The following is a list of standards which may be referenced in this section:

1. American Society for Testing and Materials (ASTM):
   a. C94, Ready Mixed Concrete.
   b. C309, Liquid Membrane-Forming Compounds for Curing Concrete.
   c. D994, Preformed Expansion Joint Filler for Concrete (Bituminous Type).
2. American Concrete Institute (ACI): ACI 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.

C. State Standard Specification: State of California, Department of Transportation.

1.03 SUBMITTALS

A. Comply with Section 01330.

B. Shop Drawings: Complete data on concrete mix, including aggregate gradations and admixtures in accordance with requirements of ASTM C94.

C. Quality Control Submittals:

1. Curing Compound: Manufacturer's Certificate of Compliance and application instructions.
2. Ready-mix delivery ticket for each truck in accordance with ASTM C94.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Conform to the State Standard Specifications for Portland Cement Concrete Pavement Construction for materials and workmanship.

PART 2 - PRODUCTS

A. Conform to the State Standard Specifications for Portland Cement Concrete Pavement.

2.02 EXPANSION JOINT FILLER

A. 1/2-inch thick, preformed asphalt-impregnated, expansion joint material meeting ASTM D994.

2.03 CONCRETE

A. Ready-mixed meeting ASTM C94, Option A, with compressive strength of 3,300 psi at 28 days.

B. Maximum Aggregate Size: 3/4-inch.

C. Slump: 2 to 4 inches.

2.04 CURING COMPOUND

A. Liquid membrane-forming, clear or translucent, suitable for spray application and meeting ASTM C309, Type 1.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Perform pavement work in accordance with the State Standard Specifications for Portland Cement Concrete Pavement.

B. Prepare subgrade and compact to 95% relative compaction in accordance with Section 02200.

3.02 FORMWORK

A. Lumber Materials:

1. 2-inch dressed dimension lumber, or metal of equal strength, straight, free from defects that would impair appearance or structural quality of completed work.

2. 1-inch dressed lumber or plywood may be used where short-radius forms are required.

B. Setting Forms:

1. Construct forms to shape, lines, grades, and dimensions.

2. Stake securely in place.

3. Brace forms to prevent change of shape or movement resulting from placement.

4. Construct short-radius curved forms to exact radius.

C. Tolerances:

1. Do not vary tops of forms from gradeline more than 1/8-inch when checked with 10-foot straightedge.

2. Do not vary alignment of straight sections more than 1/8-inch in 10 feet.

3.03 PLACING CONCRETE

A. Prior to placing concrete, remove water from excavation and debris and foreign material from forms.

B. Place concrete as soon as possible, and within 1-1/2 hours after adding cement to mix without segregation or loss of ingredients, and without splashing.

C. Place, process, finish, and cure concrete in accordance with applicable requirements of ACI 304, and this section. Wherever requirements differ, the more stringent shall govern.

D. To compact, vibrate until concrete becomes uniformly plastic.

3.04 CONCRETE CONSTRUCTION

A. Expansion Joints: Place expansion joint filler where shown and at connections to existing concrete structures.

B. Weakened Plane Joints: Place at maximum 15- foot intervals and at the beginning and end of curved portions of road paving.

1. Provide open joint type by inserting thin, oiled steel sheet vertically in fresh concrete to force coarse aggregate away from joint.

2. Insert steel sheet 0ne-inch minimum.

3. Remove steel sheet with sawing motion after initial set has occurred in concrete and prior to removing form.

4. Finish edges with steel edging tool.

C. Curing:

1. Remove and replace defective concrete.

2. Apply curing compound to exposed surfaces upon completion of finishing.

3. Protect pavement from damage and allow to cure for at least 7 days.

3.05 FINISH CONSTRUCTION

A. Sidewalk: Provide broom finish after initial float finish. Broom surface with fine-hair broom at right angles to length of walk and tool at edges, joints, and markings.

B. Pavement and Driveways: Provide final finish after initial float finish. Final finish shall include broom or burlap finish followed by a spring steel tine device to produce a 3/16-inch deep groove on ¾-inch centers.

END OF SECTION

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SECTION 02600

SHALLOW MONITORING WELLS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor furnished labor, materials, equipment, and incidentals necessary to construct monitoring wells as shown and/or specified herein. The Work shall include, but not necessarily be limited to casing, sand and gravel fill, grout seal, well head cover, well development, well construction and demolition permits, waste disposal, and all related work.

1.02 DRILLING PERMITS AND SITE CLEARANCE

A. Contractor shall obtain drilling permits from the County Department of Environmental Health.

1.03 SUBMITTALS

A. The following information shall be submitted in accordance with The General Provisions.

1. Manufacturer's Data, Certificate of Compliance, or Collected Data:
   a. PVC casing
   b. Well screen
   c. Cement grout
   d. Bentonite seal
   e. Filter pack sand samples and sieve test analyses
   f. Well cap
   g. Well development log

PART 2 - PRODUCTS

2.01 WELL CASING

A. The well riser casing shall be constructed of two-inch diameter, square-threaded and flush-jointed Schedule 40 polyvinyl chloride (PVC) well pipe. The well screen shall be two-inch diameter, slotted Schedule 40 PVC pipe. Well screen slot size shall be 0.02 inch. This slot size shall retain 90 percent or more of the selected filter pack material.

B. Casing material lengths are listed below:

1. Blank two-inch PVC casing – 0 to 5 feet
2. Two-inch PVC slotted well screen – 5 to 30 feet
3. Blank four-inch PVC casing – 30 to 35 feet

2.02 SAND FILL

A. The sand filter pack shall consist of Lonestar #2/12 washed sand, or approved equal. Bentonite slurry shall be used as a seal above the sand pack to prevent downward seepage along the casing. The remainder of the annulus shall be grouted. The grout shall be a three to five percent bentonite cement mix.

B. A sand pack shall be placed in the annular space between the well screen and the well casing wall. The sand pack shall be placed to approximately two feet above the top of the well screen. All sand shall be hard, water worn materials, washed clean of shale, mica, clay, dirt, loam and organic impurities of any kind (crushed gravel will not be accepted). The materials shall be mostly siliceous with a limit of five-percent by weight of calcareous material. It shall be well rounded and graded.

C. The sand pack and gravel pack shall be installed in the annular space between the well casing and the PVC casing through a tremie pipe from the bottom of the borehole. At no time shall the bottom of the tremie pipe be greater than five feet above the top of the sand pack during installation.

D. The sand pack placement shall continue uninterrupted until the height of the envelope reaches the specified depth. The sand pack shall be settled by working a swab opposite all screened sections until there is no further settlement of the sand; or introducing compressed air to the sounding pipe and air lifting the well until there is no further settlement of the sand. The quantities of sand initially placed around the casing and screen assembly shall not be less than the computed volume of the annular space as determined by the Engineer. A quantity less than the computed value may be judged as an indication of voids and corrective measures may be required by the Drilling Contractor. If a difference between the estimated and actual volume of sand envelope installed is found to exist, the discrepancy may be grounds for rejection of the well by the City. After consolidating the sand pack by swabbing, and upon permission from the Engineer, the Contractor may continue with the placement of the annular seals as specified.

E. A minimum of one foot of bentonite slurry shall be tremied into place above the uppermost sand pack as a seal. A weighted survey tape or equivalent shall be used to check depths and volume placed. A tremie pipe shall be used to place cement grout slurry from the top of the bentonite slurry to approximately 0.5 feet below the ground surface to seal the annulus. County Health shall be notified by Contractor 24 hours in advance of completing the well seal.

F. Borehole materials are listed below:

1. Cement grout seal – 0.5 to 2 feet below ground surface
2. Bentonite seal – 2 to 3 feet below ground surface
3. Sand fill – 3 to 40 feet

2.03 MONITORING WELL CAP

A. The PVC well casing shall be finished 3 to 6 inches below grade and equipped with a lockable well cap.

B. Monitoring well cap shall be 18 inch diameter, 12 inches deep, watertight, cast iron bolt down lid with stainless steel bolts, and “Monitoring Well” designation cast thereon as manufactured by PRM Company or equal.

C. Unit shall include a heavy duty galvanized steel skirt to maintain an open area below the lid. Unit shall be H20 traffic rated.

D. All parts shall be bituminous varnish coated.

E. Cast the well cap in concrete forming a 24-inch diameter concrete slab 6-inches deep with two rings of #4 reinforcement bar around the well cap.

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

A. Contractor shall provide all other professional services, personnel, tools, equipment, materials, and articles required to complete the monitoring well installations.

B. Contractor shall provide clean, well-maintained equipment in good operating condition and capable of completing all work specified.

C. Contractor shall allow City to verify that equipment and tools are in good working order and free of contamination.

D. The use of equipment not conforming to specifications or in poor operating condition, such as equipment leaking oil, hydraulic fluid, or other fluids, will not be allowed on site.

E. Contractor shall set up and maintain an exclusion zone around the work area, when required.

3.02 WELL DEVELOPMENT

A. At least 24 hours following construction, the well shall be developed by alternating bailing with a close-fitting bailer and surging with a vented surge block. After the sediment has been removed from the bottom of the well casing, development shall continue by pumping with a decontaminated submersible pump. The well development shall continue until pH, temperature, and specific conductivity measurements have stabilized and the water is clear and colorless, if possible.

B. Stabilization will be defined as agreement between the last two sets of readings within plus or minus 0.1 pH units, plus or minus 1.0º C, and plus or minus 10 percent of full scale reading for specific conductivity. If parameters have not stabilized during the removal of three cased well volumes, then a maximum of five well volumes shall be removed. A record of the well development shall be maintained using a well development log.

3.03 PURGE WATER AND DRILL CUTTING DISPOSAL

A. Drill cuttings shall be shovel into 55-gallon barrels or roll off bins and disposed of offsite at a legally approved site.

B. Groundwater generated during well development and sampling events that does not exceed 2.0 NTU turbidity units may be discharged to the City stormwater collection system in Kastanis Street.

C. Water exceeding 2.0 NTU turbidity units shall be collected and disposed of offsite

****END OF SECTION****

SECTION 02620

HYDRAULIC STRUCTURES DISINFECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The Contractor shall clean, flush, and disinfect hydraulic structures and appurtenant piping after completion of the reservoir, in accordance with the Contract Documents.

1.02 QUALITY ASSURANCE

A. Commercial Standards:

1. ANSI/AWWA B300 – Hypochlorites
2. ANSI/AWWA B301 – Liquid Chlorine
3. ANSI/AWWA C652 – Disinfection of Water-Storage Facilities
4. APHA/AWWA/WPCF – Standard Methods for the Examination of Water and Wastewater

1.03 TESTING

A. A testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection shall be submitted for approval a minimum of 48 hours before testing is to start.

PART 2 - PRODUCTS

2.01 MATERIAL REQUIREMENTS

A. Temporary valves, bulkheads, or other water control equipment and materials shall be as determined by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the facility or its future function.

B. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301; sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300. Liquid chlorine shall be used only (1) in combination with appropriate gas flow chlorinators and ejectors; (2) under the direct supervision of an experienced technician; and (3) when appropriate safety practices are observed.

PART 3 - EXECUTION

3.01 GENERAL

A. Water for testing and disinfecting shall be furnished by the City; however, the Contractor shall make all necessary provisions for conveying the water from the City’s designated source to the points of use.

B. All hydraulic structures and appurtenant piping shall be disinfected. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be done in the presence of the Engineer.

C. Disinfection operations shall be scheduled by the Contractor as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the work is accepted by the City. Bacteriological testing shall be performed by the City. Results of the bacteriological testing shall be satisfactory to the State Department of Health or other appropriate regulatory agency.

D. Release of water from the structure, after testing and disinfecting have been completed, shall be acceptable to the Engineer.

3.02 PRELIMINARY CLEANING AND FLUSHING

A. Prior to both testing and disinfecting, the reservoir shall be cleaned by thoroughly hosing down all surfaces with a high pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gpm. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure, collected and removed.

3.03 DISINFECTION OF RESERVOIR AND APPURTENANT PIPELINES

A. Chlorination of reservoir shall be performed in accordance with the requirements of ANSI/AWWA C652 using a combination of chlorination Methods 2 and 3 as modified herein.

B. Chlorination: A strong chlorine solution of approximately 200 mg/l shall be sprayed on all interior surfaces of the structure. Following this, the structure shall be partially filled with water to a depth of approximately one foot. During the partial filling operation, a chlorine-water mixture shall be injected by means of a solution-feed chlorinating device in such a way as to give a uniform chlorine concentration during the entire filling operation. The point of application shall be such that the chlorine solution will mix readily with the inflowing water. The dosage applied to the water shall be sufficient to provide a chlorine residual of at least 50 mg/l upon completion of the partial filling operation. Precautions shall be taken to prevent the strong chlorine solution from flowing back into the lines supplying the water. After the partial filling has been completed, sufficient water shall be drained from the lower ends of appurtenant piping to ensure filling the lines with the heavily chlorinated water.

C. Retention Period: Chlorinated water shall be retained in the partially filled structure and appurtenant piping long enough to destroy all non-spore-forming bacteria, and in any event, for at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual in the structure and appurtenant piping shall be at least 25 mg/l when tested according to Standard Methods. All valves shall be operated while the lines are filled with the heavily chlorinated water.

D. Final Filling of Structure: After the free chlorine residual has been checked, and has been found to satisfy the above requirement, the water level in the structure shall be raised to its final elevation by addition of potable water and held for 24 hours. Before final filling is commenced, the quantity of heavily-chlorinated water remaining in the reservoir after filling the piping shall, unless otherwise acceptable to the ENGINEER, be sufficient, when the water level is raised to its

final elevation to produce a free chlorine residual of between 1 and 2 mg/l. After the reservoir has been filled, the strength of the chlorinated water shall be determined. If the free chlorine residual is less than 1 mg/l, an additional dosage shall be applied to the water in the structure. After 24 hours, the free chlorine residual shall be no less than 1 mg/l or an additional dosage shall be applied and the residual tested again after 24 hours. In no case shall water be released prior to the expiration of the required retention period.

3.04 BACTERIOLOGICAL SAMPLING AND TESTING

A. Disinfected water storage facilities shall be sampled and tested in accordance with ANSI/AWWA C652.

3.05 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until all discolored water is eliminated.

END OF SECTION

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SECTION 02643

WATER PIPELINE TESTING AND DISINFECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The Contractor shall perform flushing and testing of all pipelines and appurtenant piping and disinfection of all pipelines and appurtenant piping for potable water, complete, including conveyance of test water from City's designated source to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents.

1.02 REFERENCED SECTIONS

A. Commercial Standards::

1. ANSI/AWWA B300 – Hypochlorites
2. ANSI/AWWA B301 – Liquid Chlorine.
3. ANSI/AWWA C651 – Disinfecting Water Mains

1.03 SUBMITTALS

A. A testing schedule, including proposed plans for water conveyance, control, disposal, and disinfection shall be submitted in writing for approval a minimum of 48 hours before testing is to start.

PART 2 - PRODUCTS

2.01 MATERIALS REQUIREMENTS

A. All test equipment, chemicals for chlorination, temporary valves, backflow assemblies, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future function.

B. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.

C. Liquid chlorine shall be in accordance with the requirements of ANSI/AWWA B301. Liquid chlorine shall be used only in combination with appropriate gas flow chlorinators and ejectors; under the direct supervision of an experienced technician; and when appropriate safety practices are observed.

D. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300.

PART 3 - EXECUTION

3.01 GENERALS

A. Unless otherwise provided herein, water for testing and disinfecting water pipelines will be furnished by the City; however, the Contractor shall make all necessary provisions for conveying the water from the City-designated source to the points of use.

B. All pressure pipelines shall be tested. Disinfection shall be accomplished by chlorination. All chlorinating and testing operations shall be performed in the presence of the Engineer.

C. Disinfection operations shall be scheduled by the Contractor as late as possible during the contract time period so as to assure the maximum degree of sterility of the facilities at the time the work is accepted by the City. Bacteriological testing shall be performed by a certified testing laboratory approved by the City and at the expense of the Contractor. Results of the bacteriological testing shall be satisfactory with the State Department of Health or other appropriate regulatory agency.

3.02 HYDROSTATIC TESTING OF PIPELINES

A. Contractor shall furnish all hoses, pumps, pressure gauges, leakage measuring devices, connections, relief valves, temporary pressure heads, other necessary apparatus, and personnel required for hydrostatic pressure and leakage testing. No new mains shall be placed in service until they have been disinfected and pressure tested in accordance with Section 27 of the Standard Specifications.

B. Prior to hydrostatic testing, all pipelines shall be flushed or blown out as appropriate. The Contractor shall test all pipelines either in sections or as a unit. No section of the pipeline shall be tested until all field-placed concrete or mortar has attained an age of 14 days. The test shall be made by closing valves when available, or by placing temporary bulkheads in the pipe and filling the line slowly with water. The Contractor shall be responsible for ascertaining that all test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe. Any unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test, to avoid movement and damage to piping and equipment.

C. The Contractor shall provide sufficient temporary air tappings in the pipelines to allow for evacuation of all entrapped air in each pipe segment to be tested. After completion of the tests, such taps shall be permanently plugged. Care shall be taken to see that all air vents are open during filling.

D. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the air valves at a reasonable velocity and all the air within the pipeline shall be properly purged. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb what water it will and to allow the escape of air from any air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the Engineer shall be taken.

E. The hydrostatic test shall consist of holding the test pressure on the pipeline for a period of 2 hours at 150 psig measured at the lowest point of the pipeline section being tested. No pressure test will be required for a reservoir overflow line. All visible leaks shall be repaired in a manner acceptable to the Engineer.

1. Each test section shall not exceed the maximum allowable leakage as determined using the following formula. Leakage exceeding this amount shall be cause for rejection.

$$L = SDT/12{,}500$$

Where:
L = The minimum acceptable leakage in gallons
S = The length of the test section in feet
D = The diameter of the pipe in inches
T = The test time period in hours

F. In the case of pipelines that fail to pass the prescribed leakage test, the Contractor shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipelines.

3.03 DISINFECTING PIPELINES

A. General: All potable water pipelines except those appurtenant to hydraulic structures shall be disinfected in accordance with the requirements of ANSI/AWWA C651 using the Continuous-Feed Method as modified herein. No new mains shall be connected to existing mains until they have been disinfected and pressure tested in accordance with Section 27 of the Standard Specifications.

B. Chlorination: A chlorine-water mixture shall be uniformly introduced into the pipeline by means of a solution-feed chlorinating device. The chlorine solution shall be introduced at one end of the pipeline through a tap in such a manner that as the pipeline is filled with water, the dosage applied to the water entering the pipe shall be approximately 50 mg/l. Care shall be taken to prevent the strong chlorine solution in the line being disinfected from flowing back into the line supplying the water.

C. Retention Period: Chlorinated water shall be retained in the pipeline long enough to destroy all non-spore-forming bacteria. This period shall be at least 24 hours. After the chlorine-treated water has been retained for the required time, the free chlorine residual at the pipeline extremities and at other representative points shall be at least 10 mg/l.

D. Chlorinating Valves: During the process of chlorinating the pipelines, all valves and other appurtenances shall be operated while the pipeline is filled with the heavily-chlorinated water.

E. Final Flushing: After the applicable retention period, the heavily chlorinated water shall be flushed from the pipeline until chlorine measurements show that the concentration in the water leaving the pipeline is no higher than that generally prevailing in the system or is acceptable for domestic use.

F. Bacteriological Testing: After final flushing and before the pipeline is placed in service, a sample, or samples shall be collected from the end of the line, and shall be tested for bacteriological quality in accordance with the requirements of

the State Department of Health or other appropriate regulatory agency. For this purpose the pipe shall be re-filled with fresh potable water and left for a period of 24 hours before any sample is collected. Should the initial disinfection treatment fail to produce satisfactory bacteriological test results, the disinfection procedure shall be repeated until acceptable results are obtained.

G. After disinfection of the system and prior to coliform bacteria and turbidity testing, chlorinated water shall be disposed of such that water does not flood, inundate or damage property. Contractor shall dechlorinate the water by use of apparatus that injects or mixes EPA approved chemicals with the water to neutralize the chlorine before it is released to the ground, streams, or storm sewer systems. Residual chlorine levels shall be reduced and maintained to a maximum of one hundredth of a milligram per liter (0.01 mg/l). Contractor shall test the discharge at fifteen minute (15) intervals to insure that acceptable levels of neutralization are maintained. Discharge shall be stopped if chlorine levels exceed one hundredth of a milligram per liter (0.01 mg/l). All procedures shall be in accordance with manufacturer's recommendations and as approved by the Engineer.

3.04 CONNECTIONS TO EXISTING SYSTEM

A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before they are installed. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.

END OF SECTION

SECTION 02700

PRE-CAST MANHOLES AND INLETS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnishing and installing pre-cast drainage structures.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

1. Section 01330 – Submittals
2. Section 02200 – Earthwork

1.03 SUBMITTALS

A. Comply with Section 01330.

B. Submit shop drawings and catalog cuts documenting that manholes, drainage inlets, frames, and covers conform to these specifications

PART 2 - PRODUCTS

2.01 PRE-CAST CONCRETE MANHOLES

A. Unless otherwise indicated on the plans, manholes shall conform to standard pre-cast option as specified in Sections 25 of the Standard Specifications and Standard Manhole No. 4, except flush bells shall be provided and bases shall be cast in place. Joints shall be made with preformed plastic sealing compound

2.02 FRAMES AND COVERS

A. Manhole frames and covers shall conform to the Standard Specifications and the details shown on the Standard Details. Frame and covers shall be 36-inch with the lettering “DRAIN” cast into the top for drainage manholes and include bolt down covers. Manhole frames and covers shall use stainless steel, 5 sided, raised tab, tamper proof bolts with stainless steel washer, and neoprene 0-ring seals. Manhole frames and covers shall be heavy duty with a minimum depth of 6 inches. Provide two sets of special tools for bolt removal. Bolt down manhole frames and covers shall be as supplied by D and L Supply or approved equal.

2.03 CATCH BASINS (DROP INLETS)

A. Unless otherwise indicated on the plans, catch basins shall conform to Section 20 of the Standard Specifications. Catch basins shall be pre-cast sectional catch basins with heavy duty steel grates. Grates and frames shall be hot-dipped galvanized after fabrication. Both catch basins and grates shall be suitable for H-20 wheel loading. Unless otherwise indicated, catch basins shall have 3 feet by 2 feet interior dimensions. Catch basins shall be as manufactured by Christy Concrete Products, Inc., Brooks Concrete Products, or equal.

PART 3 - EXECUTION

3.01 EARTHWORK

A. The foundations for the manholes and catch basins shall be prepared as specified in Section 02200.

3.02 CATCH BASINS

A. Pre-cast concrete sections shall be set as to be vertical and with section in true alignment. Joints shall be primed and made with sealer applied in strict accordance with the manufacturer's printed instructions. Frames and covers shall be set to the elevations shown on the Drawings in accordance with manufacturer's instructions.

3.03 MANHOLES

A. Manholes shall be constructed per the Standard Details and installed in accordance with Section 25 of the Standard Specifications.

END OF SECTION

SECTION 02770

GEOMEMBRANE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor shall furnish all labor, materials, equipment, tools and appurtenances required to complete the installation of geomembrane, complete with appurtenances, as shown, specified or required by the Plans.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

1. Section 01330 – Submittals

1.03 SUBMITTALS

A. Comply with Section 01330 and include the following:

1. Manufacturer's product data.
2. Shop drawings, including proposed panel diagram and details of proposed work.
3. Manufacturing Quality Control (MQC) data (Material Certifications) for the geomembrane to be delivered to the site. The reports shall include the quality control test results obtained during the manufacture of the material.
4. Geomembrane Sample - Samples of the proposed geomembrane.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Contractor shall protect the work described in this Section before, during, and after installation.

B. During storage, the geomembrane shall be placed on a stable, relatively flat, dry, well-drained surface.

C. If the Engineer determines the geomembrane is damaged, the Contractor shall make all repairs and replacements in a timely manner, so as to prevent delays in progress of the work.

PART 2 - PRODUCTS

2.01 GENERAL

A. The geomembrane sheet shall consist of polyvinyl chloride (PVC) resin in amounts greater than 50% of the total polymer content suitably compounded with plasticizers, stabilizers, additives, and pigments, to satisfy the physical property requirements.

2.02 GEOMEMBRANE

A. ASTM D7176 Standard Specification for non-Reinforced Polyvinyl Chloride (PVC) Geomembranes used in Buried Applications.

Certified Properties	ASTM	PVC 30
Thickness	D5199	30 ±1.5 mil
Strength at Break	D882	73 lbs/in
Tear Strength	D1004	8 lbs
Shear Strength	D882	58.4 lbs/in

2.03 FACTORY FABRICATION

A. All completed factory seams shall be 100% inspected. Factory seams will be visually inspected for full seam continuity over their full length. Any areas that do not meet the specified requirements shall be removed and repaired per section.

B. Destructive tests will be performed to verify that the seam strength requirements of the specifications are met.

C. All panels will be packaged with a protective, black stretch wrap or cardboard cover to protect the panel from weather or shipping damage.

PART 3 - EXECUTION

3.01 SITE PREPARATION

A. All required grading, grooming and construction quality assurance testing shall be complete and accepted by the Engineer prior to geomembrane placement.

B. The surface to be covered by the geomembrane shall be cleared of sharp objects, angular stones, sticks, or any materials that may contribute to punctures, shearing, rupturing or tearing of the geosynthetic materials. The subgrade shall be inspected for unsuitable areas or soft spots before the geomembrane is placed, and additional surface preparation will be required to eliminate any unsuitable areas as determined by the Engineer.

3.02 SEAMING METHODS

A. A six-inch wide overlap must be cleaned of all dust, dirt or foreign debris no more than 30 minutes prior to welding. Only clean, soft rags will be used for cleaning. If mud has adhered to the sheet surface overlap area, it will be removed with clean water and allowed to dry prior to seaming.

B. Dual-track fusion welding shall be the required method on all seams where it is feasible. Chemical welds shall be made only where approved by the Engineer.

C. Seaming will not be allowed during rain unless proper precautions are made to allow the seam to be made on dry subgrade and geomembrane materials.

D. The field seams shall be produced using Track Thermal Fusion Welding. A seam produced by melting the two intimate surfaces by running a hot metal wedge or hot air device between the surfaces, followed immediately by pressure to form a homogeneous bond.

3.03 INSTALLATION

A. The PVC panels shall be installed in a manner that minimizes seams.

B. The Contractor shall perform all activities of geomembrane construction in such a way as to avoid damage to the geomembrane.

C. No tracked or wheeled vehicles shall be permitted on the geomembrane prior to placement of adequate soil cover, as determined by the Engineer.

D. Seams shall be welded throughout the entire length of the panels during initial panel seaming.

E. Geomembrane covering operations shall be performed in a manner that does not damage the geomembrane lining system. Geomembrane covering operations shall be performed only in the presence of a Construction Observer such that the condition and cleanliness of the geomembrane is observed at the time the material is covered, and any effects of the covering operation on the geomembrane lining system can be observed.

3.04 REPAIRS

A. All geomembrane panels and seams shall be examined by the Engineer for defects, holes, blisters, undispersed raw materials, and any sign of contamination by foreign matter. The geomembrane surface shall be clean at the time of examination. Each suspect location shall be repaired and all repairs shall be non-destructively tested.

B. Damaged geomembrane shall be removed and replaced with acceptable geomembrane if damage cannot be repaired to the satisfaction of the Engineer.

END OF SECTION

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SECTION 02832

METAL FENCES AND GATES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnishing and installing the ornamental wrought iron metal site fences, gates, and related hardware. Include concrete foundations, factory painting and field touchup painting.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals
2. Section 03300 – Cast-in-Place Concrete

1.03 SUBMITTALS

A. Submit the following for Product Review in accordance with Section 01330.

B. Submit Product Data to fully describe all products proposed for use.

C. Submit custom prepared Shop Drawings showing the specific items and assemblies proposed for this project.

1.04 QUALITY ASSURANCE

A. Comply with requirements of the Fire Marshal's Fire Prevention Department that has jurisdiction for emergency operation of gated entry points.

B. All work shall be in strict conformance with manufacturer's printed instructions and recommendations.

PART 2 - PRODUCTS

2.01 FENCE

A. Provide a prefabricated prefinished 3-rail ornamental iron fence made by Ameristar (1-209-525-9711), "Montage II Invincible" style; or equivalent.

B. Overall fence height shall be 8 foot.

C. Pickets: 14-gauge by 1-inch hot-rolled structural steel tubing at 5" spacing. ASTM A513, minimum yield strength of 45 ksi. Top of pickets shall be bent with a smooth round bend, through-bend. Sharp "kinked" bend is not acceptable.

D. Frame: Hot-rolled structural steel square channels 1-3/4 inch x 1-3/4 -inch x 11 gauge, top and side, 2-inch x 4-inch x 11-gauge bottom frame. ASTM A513, minimum yield strength of 45 ksi.

E. Posts: 3-inch by 3-inch by 11-gauge hot-rolled structural steel tubing with flat top, ASTM A513, minimum yield strength of 45 ksi.

F. Hot-dip galvanize all metal components inside and out per ASTM A525-G90.

G. Insert pickets in holes punched in rails. Attach pickets to rails with welded joints. Riveted joints shall not be accepted.

H. Perforated Metal Screen: 14 gauge galvanized steel with .200" squares, 1/2" straight rows, and 16 percent open area as manufactured by McNichols Company or equal. Screen to be powder coated to match fence frame. Engineer to review sample pattern before installation. Mount to every third picket (15” OC) with self-tapping tamper proof stainless steel screws and washers. Metal screen to be banded with ¾” flat metal band on all edges.

I. Shop Finish Metal Components:

1. Power wash and rinse in warm water.

2. Zinc phosphate pre-treat and rinse in deionized water.

3. Apply polyester resin powder coating by electrostatic spray; 2.5 mils dry film thickness. Bake at 450°F for 20 minutes. Color: Black.

2.02 SLIDING GATE

A. Provide automated 20-foot wide steel slide gate.

1. All components shall be steel tube, all joints shall be welded, and all members hot-dip galvanized after fabrication.

2. Gate frame shall be 3-inch x 3-inch x 0.125-inch steel tube. Gate frame shall match fence. Weld corners to create a rigid frame. Provide a 2- x 2-inch x 11 gage steel tube top rail and verticals. Bottom rail shall be 2- x 4-inch x 11 gage steel tube with wheel housing.

3. Pickets shall be 1-inch x 1-inch x 14 gauge steel tube spaced 4-3/4-inch o.c.

4. Safety posts to be minimum 4” sq. 11 gauge steel tube. Trussing and heavier posts per manufacturer.

5. Support the bottom edge of the gate at least 8 feet on center on 4-inch-diameter 1-1/2-inch-thick sealed ball bearing mounted, lath turned "U" grooved steel wheels that run on an inverted "V" steel track the full width of the opening. Support the top of the gate with a steel wheel running on sealed ball bearings and mounted on a vertical shaft attached to the trailing post and running inside of a "U" shaped 1/8-inch-thick stainless steel track mounted on the side of the gate adjacent to the top horizontal rail.

6. Upper guide roller assemblies to be 3-inch diameter hard rubber rollers with ½-inch axle and bronze bushings and pinch guard.

7. Provide Miller Slide Gate Kit with 5 foot miller edge, multi-code transmitter and multi-code receiver.

8. Ground track to be angle iron (sized per requirements) with #5 rebar hooks welded at 24” o.c.

B. Gate Hardware

1. Gate Hardware: Sliding gate hardware, top guide rollers and bottom rollers shall be Richards-Wilcox; Stanley; or equal. Include eye bolts to permit locking gate with a padlock. Eye bolts shall be 3/8-inch minimum diameter.

2. Provide gate stop at both ends of gate. Provide open and close sensors on gate and adjacent fence.

3. Provide Fire and Security Entry Key Lock Box (total of one) for holding gate and building keys for fire and security departments. Box shall be attached to fence adjacent to entry gate as directed by Engineer and lock box supplier. Lock box shall be as manufactured by Knox Company.

4. Gate Operator: Door King Model 9150, 1 HP, 115 VAC. Provide nickel plated chain. Programmable time delays which will close the gate after a preset time if the area adjacent to the gate is unoccupied.

5. Entrance and Exit Gate Access: Door King Model 1850-390 with an 1815-382 ThinLine II Proximity Card Reader housed in a two-piece, weatherproof secure potted enclosure. Gate shall be opened from access card readers and keypads for access to site and for exiting from site.

6. Loop detectors: DoorKing 9406-010, single channel, plug in type loop detectors. Safety loop detectors shall prevent gate closing on vehicle during entering and exiting tank and pump station site.

7. The electrical gate operator shall interface with the access system and safety loops for gate control. Provide manufacturers recommended connection cable between card reader and gate operator and all related appurtenances for a fully operational system.

2.03 PERSONNEL GATE (SWING GATE)

A. Gate: 4-feet-wide by 8-feet-high (top of gate shall align with the top of the fence) swinging gate.

B. Picket Infill: “U” channel rails, formed from hot-rolled structural steel, 1-3/8 inches wide by 1-1/2 inches deep, 11 gauge, Punch "U" rails to receive pickets, and welded inside gate frame. Pickets to match fence pickets. Attach pickets to "U" rail with ¼-inch minimum diameter industrial drive rivets.

C. Hinges: Galvanized or stainless steel, 0.080-inch minimum thickness, non-lift style, non-removable pin, minimum two per gate, allowing for a full 180-degree swing.

D. Latch: Provide double lock box latch and lever handle. Lever handle shall be on each side of gate and disengage the latch. Latch shall be capable of maintaining the gate in a closed position with a 500-pound lateral load. Provide locking hardware to match the building door.

E. Keeper: Provide a keeper that holds the gate in a fixed open position. Keeper shall be a cane bolt that is inserted into a strike in the pavement or hook that is inserted into an eyebolt on the fence.

F. Gate Posts: 3 inch square by 12 gauge, same construction as fence posts. Embed hinge side gatepost a minimum of 4 feet below grade.

G. Finish: Same finish as fence.

PART 3 - EXECUTION

3.01 CONCRETE FOUNDATION

A. Layout fence alignment and post locations.

B. Excavate for foundations. Fence posts shall be set in a minimum 3-foot deep by 18-inch diameter holes except where indicated otherwise on the Plans or when the manufacturer recommends deeper or wider holes.

C. Pour concrete for foundations in accordance with Section 03300.

D. Set steel fence post in place and brace in a plumb, vertical position.

E. Do not install fence or remove braces until concrete has set at least 7 days.

3.02 INSTALLING FENCES

F. Install metal fence panels with metal brackets and tamper proof screws.

G. Make connection between fence panel and inserts cast into precast concrete posts. Field welding not allowed.

H. Field touchup paint connections. Paint shall match and be approved by the manufacturer for touchup coating.

I. Top of pickets should face to the outside of the site.

3.03 INSTALLING GATES

J. Install slide and swing gate sections and hardware in accordance with manufacturer's instruction.

K. Adjust gates for smooth easy operation.

END OF SECTION

SECTION 02910

IRRIGATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work in this section includes installation of a complete automatic irrigation system, including excavation for points of connection, trenching, piping, equipment, electrical components and incidentals related thereto.

1.02 REFERENCED SECTIONS

A. The following Section is are referenced in this Section

1. Section 01330 – Submittals

1.03 QUALITY CONTROL

A. Standards: Unless otherwise shown or specified, all materials and methods shall conform to Section 20-5 of the State of California Department of Transportation Standard Specifications (DTSS) as they reasonably apply to this work except for measurement and payment requirements.

1.04 SUBMITTALS

A. Comply with Section 01330.

B. Contractor shall specifically request the following reviews prior to progressing with the work:

1. Layout of system.
2. Points-of-connection excavation.
3. Trenching and pipe assembly.
4. Coverage adjustment of all heads and valve box installation.
5. Operation of system.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Quality: All materials shall be new and the best quality available unless otherwise specified. All materials shall be clearly marked by manufacturer on all material, containers, or certificates of contents for inspection.

B. Plastic Pipe and Fittings: All mainline pipe 3/4" – 1-1/2” in size shall be polyvinyl chloride (PVC) Schedule 40; sizes 2” – 3” shall be Class 315; and sizes 4” and larger shall be Class 200 twin-seal gasketed pipe. Unless otherwise noted, all laterals shall be Class 200 PVC pipe; solvent weld fittings, if used, shall be Schedule 40, or Schedule 80 as called for on details. Solvent for piping shall be as recommended by manufacturer. All pipe shall be clearly labeled with manufacturer type and specification numbers.

C. Control Wire: Type UF, 600 v. insulation, minimum size #14, copper, common to be white, valve control wire to be red or black, U.L. approved for irrigation control use; splices shall be "Scotch-Lok" seal pack, or equal.

D. Valve Boxes: Precast concrete of type and size indicated; free of all cracks, chips or structural defects. Boxes subject to vehicular traffic shall be concrete and have heavy duty steel covers. Boxes shall be sized to provide a 4” minimum clearance around the irrigation equipment inside the box, excluding all pipes and fittings.

E. Irrigation Equipment: Refer to drawings. Any desired substitutions require submittals in duplicate for specific written approval.

F. Thread Sealant: Permatex Thread Sealant, part #14H, white in color.

PART 3 - EXECUTION

3.01 GENERAL

A. GRADING: Contractor shall be responsible for installing all irrigation features to their finished grade and at depths indicated. All rough grading shall be completed before trenching commences.

B. LAYOUT AND TRENCHING: All features of the irrigation system shall be staked and pipe alignments marked prior to trenching for review by the Engineer.

C. BACKFILLING: Do not cover joints until system has been reviewed by the Engineer. Backfill with damaging rocks and debris shall not be permitted. Compact all backfill and eliminate settlement. Previously prepared soil is to be replaced as the top six inches of backfill.

D. FABRICATION: Snake pipe from side to side when trench exceeds thirty feet in length. All manifolds shall be neat, orderly, and constructed for ease in maintenance operations. Construct manifolds to allow valve boxes to be parallel to each other and to adjacent walls, walks, curbs, and buildings. Cuts and joints shall be free of burrs, smooth, and minimum in quantity. All pipe above finish grade shall be galvanized unless noted otherwise.

E. PIPELINES: All pipelines shown parallel on the drawing may be installed in a common trench. Where pipelines are shown parallel or adjacent to shrub or groundcover areas, they shall be installed in these areas. All changes in depth of pipe shall be accomplished using 45-degree fittings.

F. TESTING: Test mainline at 125 psi for six (6) hours. Test and repair as necessary until satisfactory test conditions are obtained.

G. CONTROL WIRE: Install control wire in pipe trenches wherever practical. Tape to underside of pipe every ten feet. Loop wire every 20 feet. Splices shall occur in valve boxes only and shall be accomplished utilizing approved connectors. All wire shall be installed below or level with the bottom of adjacent pipes. All wiring above finish grade shall be enclosed in steel conduit. Splices shall be installed in junction boxes.

H. ADJUSTMENTS: Adjust all heads for arc, radius, riser height, and distribution for uniform and optimum coverage. Such adjustments shall include nozzle changes without additional cost to the City.

I. FINISH GRADE: Unless otherwise noted, all heads shall be set at finish grade and on double or triple swing joints as called for on drawings. The top of all valve boxes shall be flush with finish grade.

J. CONTROLLER: Contractor shall clearly label and sequence stations for ease in maintenance operations. Station valves to operate as they are located around the site. Fasten controller and wire conduits securely to wall with conduit clamps and screws. Contractor shall complete all forms and labels shipped with and/or attached to the controller; attach his own name, address and phone number to the controller via a permanent label; and shall properly execute and file with the City the controller and valve guarantees.

K. RECORD DRAWING: Contractor shall regularly update a print of the system and any changes made to the system throughout the project. Features below ground shall be indicated with at least two measurements from surface features such as walks, building, or sprinkler heads. All changes shall be recorded on this plan before trenches are backfilled. The record drawing shall be completed and submitted to the City before final payment shall be made for work installed.

END OF SECTION

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SECTION 02911

LANDSCAPE SOIL PREPARATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish and install all landscape soil preparation as shown and specified, including, but not necessarily limited to, the following: topsoil placement, organic amendment and fertilizer placement, and finish grading.

1.02 QUALITY CONTROL

A. Reviews: Contractor shall specifically request at least two working days in advance the following reviews prior to progressing with the work:

1. Completion of rough grading
2. Verification of amendment incorporation depths
3. Finish grade

B. Certification: Written certificates stating quantity, type, and composition, weight and origin for all amendments and chemicals shall be delivered to the Owner's Representative before the material is used on the site.

C. Soil Samples

1. Contractor shall provide a one-quart sample of the native topsoil to Soil and Plant Laboratory of Santa Clara, (408) 727-0330, for their testing for conformance to this specification.
2. No material shall be delivered to the site, graded on-site, or otherwise modified until the Owner's Representative approves the material.
3. All testing costs shall be paid for by the Contractor.
4. Allow for sufficient time for such testing prior to construction.
5. Testing costs for the initial samples and costs for any additional samples due to non-compliance shall be paid for by the Contractor.

D. Amendment Samples

1. Provide a one-quart sample of each proposed amendment to Soil and Plant Laboratory of Santa Clara, (408) 727-0330, for their testing for conformance to this specification.
2. No material shall be delivered to the site until the Owner's Representative approves the samples.
3. Testing costs shall be paid for by the Contractor.

E. Planting Areas

1. All areas to be planted, whether in seed, sod, container stock, flats, or otherwise, are defined as planting areas in these documents.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Native Topsoil

1. Shall be the existing surface layer of soil on site.
2. This layer typically will be a different color and texture than the subsoil, and may be of varying thicknesses.
3. The Contractor shall be responsible for reviewing the area limits and depths of native topsoil on site with the Owner's Representative.

B. Soil Amendment

1. Shall be determined from soils analysis results. For purposed of bidding only, assume the use if:
   a. Green waste Compost organic content of at least 260 pounds per cubic yard.
   b. Agricultural Gypsum.

PART 3 - EXECUTION

3.01 LIMITS AND GRADES

A. Grade Review

1. Prior to commencing soil preparation operations, Contractor shall request a review by the Owner's Representative to verify specified limits and grades of work completed to date and soil preparation work to commence.
2. Contractor shall complete the rough grading as necessary to round the top and toe of all slopes, providing naturalized contouring to integrate newly graded areas with the natural topography.
3. Finish grading under this section shall be completed in accordance with the grades indicated on the landscape drawings.

3.02 STRIPPING AND STOCKPILING OF EXISTING TOPSOIL

A. Excavation Areas: In the areas where existing grade will be excavated, the native topsoil shall be stripped and stockpiled on-site in sufficient quantities to place a six-inch layer. Topsoil to be stripped and stockpiled shall be taken from the surface layer after all organic litter and foreign debris has been removed and properly disposed.

B. Existing Grade Unchanged: In those areas where grades are not proposed to be modified (areas of no excavation or fill) the native topsoil shall be left in place. All debris, as well as all rocks over 0.75 inches in diameter, shall be removed from the surface of planting areas.

3.03 TOPSOIL PLACEMENT

A. Topsoil Incorporation

1. In all planting areas that have been excavated, rip the surface to a depth of ten inches.

2. Next, a three-inch layer of native topsoil shall be uniformly distributed over these areas and thoroughly incorporated into the top six inches of subsoil by ripping, scraping, or tilling to mix the subsoil with the topsoil into a homogeneous mixture.

3. The remaining layer of topsoil (three inches) shall then be uniformly distributed in the planting areas and compacted in place to 85% compaction.

B. Existing Topsoil to Remain

1. In those planting areas where native topsoil is to be left in place, cross rip to a depth of ten inches. Then incorporate the amendments to a homogeneously blended soil depth of six inches.

3.04 ORGANIC AMENDMENT AND FERTILIZER INCORPORATION

A. Materials and Rates: Materials determined from the soils test shall be uniformly distributed throughout all irrigated planting areas and incorporated to a homogeneously blended soil depth of six inches. Assume per 1000 square feet:

1. 6 cubic yards Greenwaste Compost

2. 100 pounds Agricultural Gypsum

3.05 PLANT PITS

A. Plant Pit Preparation: Plant pits shall have their sides and bottoms loosened or otherwise broken to prevent glazed or compacted surfaces, and shall be as shown on the planting detail.

3.06 BACKFILL

A. Backfill Material and Placement

1. Only unamended soil shall be used beneath the root ball; cultivate bottom of plant pit to improve porosity.

2. Backfill around sides of root ball shall be the amended soil taken from adjacent prepared areas.

3. Spread material excavated from plant pits onto adjacent areas as replacement.

4. Should additional backfill be necessary, a mixture of two parts pulverized site soil to one part Greenwaste Compost uniformly blended with five pounds Agricultural Gypsum may be used.

3.07 PLANT TABLETS

A. Tablet Quantities: All container plants shall receive plant tablets as follows:

a.	one-gallon plants	two 21-gram tablets
b.	five-gallon plants	five 21-gram tablets
c.	fifteen-gallon plants	twelve 21-gram tablets
d.	24 inch box trees	eighteen 21-gram tablets

B. Space the tablets evenly around the root ball halfway up backfill touching side of root ball. Owner's Representative may require excavation of up to 5% of all plants selected at random for conformance review.

3.08 FINISH GRADING

A. Grading Operations

1. Contractor shall finish grade all irrigated planting areas unless otherwise noted, and shall remove all rocks and clods over one cubic inch to a depth of one inch below finish grade.

2. All areas shall be smooth and uniformly graded.

3. All erosion damage during the construction period shall be repaired by the Contractor.

B. Finish Grades

1. Unless otherwise noted, all soil finish grades shall be one inch below finish grade of walks, pavements, and curbs.

END OF SECTION

SECTION 02934

PLANTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnished and installed container plantings, groundcover, staking, and related work thereto.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

1. Section 01330 – Submittals
2. Section 02911 – Landscape Soil Preparation

1.03 QUALITY CONTROL

A. Reviews: The Contractor shall specifically request the following reviews prior to progressing with the work:

1. Plant material approval
2. Plant layout
3. Finish grade
4. Substantial completion
5. Final completion

1.04 SUBMITTALS

A. Comply with Section 01330.

B. Plant Material

1. Within fourteen days after award of contract, Contractor shall submit notice to the Owner's Representative certifying the quantity and species of plant material ordered, the nursery supplying the material, any plant material unavailable at the time, and proposed plant substitutions.
2. No plants shall be ordered or delivered prior to written acceptance by the Owner's Representative.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Nomenclature and Labels

1. Plant botanical names shall conform to "Standardized Plant Names", second edition, and secondly, "A Checklist of Woody Ornamental Plants of California", Manual 32, University of California.

2. All plants of each clone, species, and cultivar shall be delivered to the site labeled with their full botanical names.

3. Every plant species shall be labeled with no less than one label for every ten plants of a species.

B. Quality

1. Minimum quality of all plant material shall conform to prevailing published specifications of the California Association of Nurserymen and the American Association of Nurserymen's American Standard for Nursery Stock unless otherwise indicated.

2. Additional specifications shall be indicated on the drawings.

C. Quantities

1. The quantities shown on the plant list and in labels are for the Owner's Representative's use and are not to be construed as the complete and accurate limits of the contract.

2. Contractor shall furnish and install all plants shown schematically on the drawings.

3. Any unlabelled plants shall be considered as the smaller size shown for that type on the drawings.

D. Root Systems

1. All container-grown stock shall be grown in its container for at least six months prior to its planting.

2. Contractor shall allow one percent of the quantity of plants for removal and inspection.

3. Any plant material, within one year following the final acceptance of the project, determined by the Owner's Representative to be defective, restricted, declining or otherwise deficient due to abnormal root growth, shall be replaced by Contractor to the equal condition of adjacent plants at the time of replacement.

E. Trees

1. All trees shall have straight trunks of uniform taper, larger at the bottom.

2. Trunks shall be free of damaged bark, with all minor abrasions and cuts showing healing tissue.

3. Sucker basal growth and sucker lateral growth shall be removed and treated to eliminate resprouting.

4. Normal lower side branching shall remain.

5. Trees unable to stand upright without support shall be rejected.

F. Health

1. Foliage roots and stems of all plants shall be of vigorous health and normal habit of growth for its species.

2. All plants shall be free of all diseases, insect stages, burns, or disfiguring characteristics.

G. Untrue Species

1. All plant material, within two years following the final acceptance of the project, determined by the Owner's Representative to be untrue to the species, clone, and/or variety specified, shall be replaced by the Contractor, to the equal condition of adjacent plants at the time of replacement.

H. Sod/Lawn

1. Shall be minimum 95% purity and 85% germination.
2. Inert matter shall not exceed 2.0% nor weed content 0.00%, with no noxious weeds.
3. Sod type shall be as indicated on the drawings. Sod shall have a well-developed root structure sufficiently mature so that it will hold together when held by one end of the roll.
4. Yellowing, brown, diseased, dried, or pest infested sod shall be rejected.
5. Soil thickness of the sod shall be 1/4 inch to 5/8 inch thick excluding top-growth and thatch; top-growth shall be uniformly mowed to 1-1/2 inch to 2 inches for bluegrasses and ryegrasses with excess clippings and surface debris removed; size of rolls or slabs shall be consistent to the suppliers standard length and width and is not to vary by more than 2% in either dimension.

PART 3 - EXECUTION

3.01 GENERAL

A. Plant Material Approvals

1. Before planting operations commence, all or a representative sampling of plant material shall be reviewed at the site by the Owner's Representative.
2. Defective plants installed without such review shall be removed from the site upon request by the Owner's Representative and an acceptable plant substituted in its place.

B. Layout

a. Only those plants to be planted in any single day shall be laid out. Locations of all plants shall be reviewed prior to planting.
b. Plants installed without this review shall be transplanted as directed by the Owner's Representative.

C. Protection of Plants

1. Maintain all plant material in a healthy growing condition prior to and during planting operations.
2. Contractor shall be responsible for vandalism, theft and damage to plant material until the commencement of the maintenance period.

D. Root Systems

1. Contractor shall be responsible for inspection of all root systems on plant materials.
2. Inspection shall include, but not be limited to, checking for rootbound stock, encircling roots at the perimeter of the container, girdling roots at the top surface of the root ball, and other defective root conditions.
3. Such inspections shall include the complete removal of soil from one percent of plant material containers, or at least one plant from each nursery and each plant type.
4. Contractor shall cut defective or potentially defective girdling, rootbound, and encircling roots and spread the root system into the surrounding backfill.
5. Plants with excessively defective root systems shall be rejected by the Contractor.

E. Pruning

1. Contractor shall do no pruning without the specific approval of the Owner's Representative.
2. Plants pruned without approval shall be replaced by the Contractor, if required.

F. Basins

1. Construct basins as necessary to water plants.
2. Remove basins from all plants under a permanent irrigation system prior to final inspection and finish grade the planting area.
3. Basins for plants to be hand-watered shall remain in place.
4. Basin bottoms shall drain to berm away from plant stem.

G. Staking

1. All trees shall be staked as drawn with stakes driven securely into existing soil aligned with the trunk and perpendicular to the direction of the prevailing winds.
2. A minimum of two figure-eight wire and rubber tree ties required per stake.

H. Plant Pits, Backfill and Finish Grading:

1. See Section 02911 for materials and installation requirements.

I. Cleanup

1. After completion of all operations, Contractor shall remove all trash, excess soil and other debris.
2. All walks and pavement shall be swept and washed clean, leaving the entire area in a neat, orderly condition.

J. Sod Installation:

1. Finish grade to smooth even surface allowing for sod thickness at pavement and other structures to leave the sod one-half inch below the finish grade of adjacent structures.
2. The soil surface shall be sufficiently firm to resist impressions over one-quarter inch deep, and shall be lightly rolled until meeting this firmness.
3. The top six to eight inches of soil shall be watered until this zone has an optimum moisture content for root growth.
4. Sod shall be laid in rows with staggered ends neatly and tightly butted on all edges.
5. Sod shall be protected from wind and sun exposure during storage with a maximum storage period of twenty-four hours.
6. No overlap, gaps, ripples, or other uneven pavement will be accepted.
7. Contractor shall lightly roll all sod after installation to insure optimum contact with the soil.
8. Trimming and cutting around structures shall be completed with sharp tools and carefully fitted so the final appearance is a solid continuous turf.

END OF SECTION

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SECTION 02935

LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work in this section includes the growing and maintenance operations necessary to establish the newly planted shrubs, trees, and other plantings; to provide insect and disease control, and to maintain the irrigation system, and related construction elements.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals
2. Section 02934 – Planting

1.03 SUBMITTALS

A. Comply with Section 01330.

B. Soil Testing: Contractor shall collect two one-quart samples in the container planting areas of the in-place topsoil 20 days after completion of planting and submit to Soil and Plant Laboratory of Santa Clara, (408) 727-0330, for maintenance period fertilizer recommendation. Test results shall be made available to the City's Representative. Sample shall be a representative composite taken from several planting areas. Cost of soil test shall be paid for by the Contractor.

C. Herbicide/Fungicide/Insecticide: Submit a written recommendation from a State of California appropriately licensed individual along with complete product data from proposed manufacturer, for review by City Inspector and/or City's appropriately licensed individual.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Fertilizer: Used during the course of the maintenance period shall be determined by soils test required under Part 1 of this Section. For bidding purposes only, assume the following:

1. In Sodded Areas: Use (16-6-8) fertilizer at 4 lbs. per 1,000 SF
2. In all Other Planting Areas: Use ammonium sulfate (21-0-0) at 5 lbs. per 1,000 SF.

B. Water: During the course of construction and maintenance period water shall be paid for by the Contractor.

C. Herbicide/Fungicide/Insecticide: Shall be a commercially available chemical recommended for this project and these plantings by a State of California appropriately licensed individual. The licensed individual shall review all planting, including but not limited to seed, sod, groundcovers, shrubs, and trees, the types

and extent of soil preparation, the irrigation systems, drainage patterns, and other project characteristics to verify type, compatibility, and recommend the appropriate chemical(s) for use. Contractor shall be responsible for all overspray, spreading, runoff, plant health, and other impacts from the use of the chemical(s).

PART 3 - EXECUTION

3.01 GENERAL

A. TIME LIMITS: The maintenance period shall commence from the date of substantial completion of planting as defined in paragraph 3.6 below, and extend for a thirty day period thereafter, or until the acceptance of Final Completion.

B. FERTILIZER APPLICATION: Fertilizer(s) shall be applied per Soil and Plant Laboratory recommendations. For bidding purposes, assume initial application to be two weeks after planting for sod and immediately after planting for all other planting areas. Subsequent applications to be at 45-day intervals.

C. HERBICIDE APPLICATION: Herbicide shall not be used until all plant material has been planted a minimum of 20-days. All planting areas shall be kept weed-free by non-herbicide methods during this time period. Herbicide shall not be applied to any areas that are or have been seeded. Contractor must apply the material in conformance with the written recommendations of the State appropriately licensed individual.

D. BASIC REQUIREMENTS: All planting areas shall be kept weed-free at all times during the maintenance period. All pest and disease control shall be the Contractor's responsibility. All planting areas shall be kept at optimum moisture for plant growth. Settlement of soil and plants and soil erosion shall be repaired and areas replanted as required. Dying or deficient plants shall be replaced as soon as they become apparent.

E. CITY'S RESPONSIBILITY: Work installed under this contract that is damaged or stolen prior to Substantial Completion shall be repaired or replaced by the Contractor without cost to the City. After Substantial Completion and through the maintenance period, these damages and similar factors such as extensive litter, abuse and defacement shall be the City's responsibility to repair or replace and shall not be a part of this contract. No planting shall be guaranteed beyond the maintenance period, except as to conformance to specified species and variety, and except as to conditions specified under "Root Systems" of Section 02934.

F. SUBSTANTIAL COMPLETION: Shall be deemed as the time all major plantings, including groundcover, are installed, and when all other work is satisfactorily completed (with the exception of minor items to be completed as noted upon a checklist compiled by the City's Representative). Maintenance period shall not commence until work is deemed substantially complete by the City's Representative.

G. FINAL REVIEW: Contractor shall request a final review of the project at least five days in advance of the proposed date. Failure to request this notice shall automatically extend the date of completion. The maintenance period will continue until project is deemed complete.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE FOR CONCRETE TANKS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Cast-in-place concrete for potable water storage reservoirs which consists of furnishing all material, mixing and transporting equipment, and performing all labor for the proportioning, mixing, transporting, placing, consolidating, finishing and curing of concrete in the structure. Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, natural pozzolans, admixtures, and water as hereinafter specified.

B. Concrete in contact with potable water shall be water quality tested per Article 2.02 C.

1.02 REFERENCED SECTIONS:

A. The following Sections are referenced in this Section:

1. Section 01330 - Submittals
2. Section 03100 - Concrete Formwork
3. Section 03370 – Prestressed Concrete Reservoir
4. Section 07920 – Sealants

1.03 QUALITY ASSURANCE

A. Basis for Quality

1. Cast-in-place concrete shall conform to the requirements of ACI 301, except as modified herein.

B. References

1. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed standards, the requirements of this section shall prevail.

Standard	Title
AASHTO T210	Aggregate Durability Index
ACI 211.1	Selecting Proportions for Normal, Heavy Weight and Mass Concrete
ACI 214	Evaluation of Strength Test Results of Concrete
ACI 301	Structural Concrete for Buildings
ACI 304	Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306R	Cold Weather Concreting
ACI 347R	Concrete Formwork

Standard	Title
ASTM C31	Making and Curing Concrete Test Specimens in the Field
ASTM C33	Concrete Aggregates
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C42	Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C94	Ready-Mixed Concrete
ASTM C117	Materials Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C142	Clay Lumps and Friable Particles in Aggregates
ASTM C143	Slump of Portland Cement Concrete
ASTM C150	Portland Cement
ASTM C157	Length Change of Hardened Cement Mortar and Concrete
ASTM C172	Sampling Freshly Mixed Concrete
ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C289	Potential Reactivity of Aggregates (Chemical Method)
ASTM C494	Chemical Admixtures for Concrete
ASTM C595	Blended Hydraulic Cements
ASTM C618	Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
CRD-C572	Corps of Engineers Specifications for Polyvinylchloride Waterstop
NSF/ANSI 61	Drinking Water System Components – Health Effects

1.04 SUBMITTALS

A. Comply with Section 01330 and submit the following information for review:

1. Manufacturer's Data

   a. Proposed concrete mix designs
   b. Waterstops
   c. Retardants
   d. Curing Compounds
   e. Bonding compounds
   f. Pozzolan
   g. Expansion joint material
   h. Contraction joint material
   i. Admixture
   j. Patching Materials

2. Laboratory Test Reports

a. Before delivery of materials, four copies of the reports of the tests specified herein shall be provided.

b. Test reports on previously tested materials shall be accompanied by the manufacturer's statement that the previously tested material is the same type, quality, manufacture and make as that proposed for use in this project.

c. Test reports are required for the following:

1) Cement
2) Aggregates
3) Pozzolan
4) Admixtures
5) Curing compounds
6) Retardants
7) Bonding compounds
8) Concrete mix design test with slump, cylinder compression, absorption and shrinkage tests.
9) Water quality testing for concrete in contact with potable water.

3. Field Sampling

a. Field sampling and testing shall be performed by the Contractor at an approved testing laboratory.

b. Concrete strengths shall be verified by testing standard cylinders of concrete samples taken at the job site.

c. A final report, prepared by the Contractor's testing laboratory, shall be provided at the completion of all concreting testing.

4. NSF/ANSI 61 certification for cement and admixtures for concrete in contact with potable water.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement

1. Portland cement shall be ASTM C150, Type II or Type V, low alkali, containing less than 0.60 percent alkalies. Portland-pozzolan cement shall be ASTM C595, Type IP(MS), interground, low alkali.

B. Aggregates

1. General

a. Except as modified herein, fine and coarse aggregates shall conform to ASTM C33. Fine and coarse aggregates shall be regarded as separate ingredients. Aggregates shall be nonreactive and shall be washed before use.

b. Tests for size and grading of fine and coarse aggregates shall be in accordance with ASTM C136. Combined aggregates shall be well and uniformly graded from coarse to fine sizes to produce a

concrete that has optimum workability and consolidation characteristics. The final combined aggregate gradation shall be established during the design mix.

c. When sources of aggregates are changed, test reports shall be provided for the new material. The tests specified shall be performed prior to commencing concrete work.

2. Fine Aggregate

a. Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine. Gradation shall conform to ASTM C33. Fine aggregate shall not exceed 40 percent by weight of combined aggregate total, except for concrete with coarse aggregate of less than maximum size 1/2 inch.

b. Variations from the specified gradations in individual tests will be acceptable if the average of three consecutive tests is within the specified limits and the variation is within the permissible variation listed below:

1) Sieve Size, 30 and coarser - 2 % Permissible Variation

2) Sieve Size, 50 and fine - 0.5 % Permissible Variation

c. Other tests shall be in accordance with the following specifications:

1) ASTM C117, amount of material: 3 percent passing No. 200 sieve maximum by weight

2) ASTM C289, reactivity: As specified in ASTM C33

3) ASTM D2419, sand equivalent: Minimum 75

3. Coarse Aggregate:

a. Coarse aggregate shall be hard, dense and durable gravel or crushed rock free from injurious amounts of soft and friable particles, alkali, organic matter. Other deleterious substances shall not exceed the limits listed in ASTM C33, Table 3. Gradation of each coarse aggregate size specified herein shall conform to ASTM C33, Table 2.

b. Before and during field trial mixes, the Contractor may make minor adjustments to the above gradation to produce the specified concrete.

c. During progress of the work, variations from the specified gradations will be acceptable in individual tests if the average of three consecutive tests is within the specified limits.

d. Other tests shall be in accordance with the following specifications:

1) Durability index, AASHTO T210 -- Minimum 75

2) Soundness, ASTM C88 -- 10 percent maximum loss with sodium sulfate

3) Amount of material, ASTM C117 -- 1.0% max passing No. 200 sieve

4) Abrasion, ASTM C131 -- 35% maximum loss after 500 revolutions

5) Clay lumps and friable particles, ASTM C142 -- 4.5 percent maximum

6) Reactivity, ASTM C289 -- As specified in ASTM C33

C. Pozzolan

1. Pozzolan shall be Class N natural pozzolan conforming to ASTM C618. Pozzolan supplied during the life of the project shall have been formed at the same single source. The pozzolan color shall not substantially alter the resulting concrete from the normal gray color and appearance.

D. Admixtures

1. General: Admixtures shall be compatible with the concrete and by a single manufacturer. Calcium chloride or admixtures containing calcium chloride are not acceptable. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the concrete mix.

2. AIR ENTRAINING AGENT: Air entraining agent shall be Euclid Chemical Company, AEA-92; W. R. Grace and Co., Darex II; or approved equal. The air entraining agent added shall produce, in accordance with ASTM C260, an entrained air content between 3 and 5 percent.

3. SET CONTROLLING AND WATER REDUCING ADMIXTURES: Admixtures may be added at the Contractor’s option to control the set, effect of water reduction, and increase workability. The addition of an admixture shall be at the Contractor’s expense. The use of an admixture shall be subject to acceptance by the Engineer. Admixtures specified herein shall conform to the requirements of ASTM C 494. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

a. Set controlling admixture shall be either with or without water-reducing properties. Where the air temperature at the time of placement is expected to be consistently over 80 degrees F, a set retarding admixture such as Eucon Retarder by Euclid Chemical Company; Daratard 17 by W.R. Grace and Co.; or equal shall be used. Where the air temperature at the time of placement is expected to be consistently less than 40 degrees F, a non-corrosive set accelerating admixture such as Accelguard 80 by Euclid Chemical Company; Daraset by W.R. Grace and Co.; or equal shall be used.

b. Normal range water reducer shall conform to ASTM C 494, Type A and shall be Eucon WR-91 by Euclid Chemical Company; WRDA 64 by W. R. Grace and Co.; or equal.

c. High range water reducer shall conform to ASTM C 494, Type F or G and shall be Eucon 1037 by Euclid Chemical Company; ADVA 190 by W.R. Grace and Co.; or equal. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating water cement ratio.

d. If the high range water reducer is added to the concrete at the job site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3 inches ± ½-inch prior to adding the high range water reducing admixture at the job site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the job site system.

e. Concrete shall be mixed at mixing speed for a minimum of 30 mixer revolutions after the addition of the high range water reducer.

E. Synthetic Fiber Reinforcement:

1. Material: 100 percent virgin homopolymer polypropylene multifilament fibers, containing no reprocessed olefin materials.

2. Conformance: ASTM C 1116, Type III.

3. Fibers shall be Microfiber by Grace, Fibermesh 150 by Propex, or equal.

4. Fiber lengths shall be a maximum of ¾ inches. The amount of polypropylene fibers added to the concrete mix shall conform to the manufacturer's recommendations.

F. Water

1. Water for washing aggregate, for mixing and for curing shall be free from oil and deleterious amounts of acids, alkalies, and organic materials; shall not contain more than 500 mg/l of chlorides as Cl, nor more than 800mg/l of sulfates as SO4; and shall not contain an amount of impurities that may cause a change of more than 25 percent in the setting time of the cement nor a reduction of more than 5 percent in the compressive strength of the concrete at 14 days when compared with the result obtained with distilled water.

2. Additionally, water used for curing shall not contain an amount of impurities sufficient to discolor the concrete.

2.02 CONCRETE CHARACTERISTICS

A. Mix Proportioning

1. Concrete shall be normal weight concrete composed of specified cement, pozzolan, admixtures, aggregates and water proportioned and mixed to produce a workable, strong, dense, and impermeable concrete.

2. The Contractor may substitute interground portland-pozzolan cement conforming to ASTM C595, containing the specified amount of pozzolan in lieu of portland cement and pozzolan. Water/cement ratio is based on the combined contents of cement and pozzolan in a given mix proportion.

3. Compressive strength shall be determined at the end of 7, 14, and 28 days based on test cylinders made and tested in accordance with ASTM C39.

4. Pozzolan shall equal 18 to 20 percent by weight of Portland cement.

B. Control Tests

1. Mix Design

a. Before beginning concrete work, the Contractor shall submit mix designs for the various strengths and classes of concrete to the Engineer for approval per Paragraph 1.04.

b. Upon approval of the concrete mix designs, the Contractor shall make arrangements for field trial batches with his supplier and the Engineer.

2. Field Trail Mix

a. After acceptance of laboratory mix design and prior to concrete placement, the Contractor shall establish, based upon the accepted design mixes, field proportions for the classes of concrete required.

b. Field trial concrete shall be manufactured using the equipment to be used for the work.

c. Minor adjustments shall be made in the design mixes to provide a dense, homogeneous, durable concrete with good workability and finishing qualities.

d. Six standard test cylinders shall be obtained from the field trial mixes for each concrete mix design and tested as specified for mix design test cylinders.

e. Drying shrinkage shall be measured as specified in Paragraph 2.02.B.3. Sampling and testing of concrete shall be done by the independent testing laboratory.

f. Certified copies of the laboratory test results shall be submitted to the Engineer.

g. Concrete shall not be placed in the field prior to acceptance of the field trial mix.

3. Drying Shrinkage

a. Drying Shrinkage: Drying shrinkage specimens for roof and floor concrete shall be prepared from the same concrete used for preparing compression test cylinders for mix design and for field trial mix and are required for all tank roof and floor concrete.

b. From each mix, three specimens shall be prepared. The drying shrinkage specimens shall be 4 x 4 x 11 inch prisms with an effective gage length of 10 inches, prepared, cured, dried and measured in accordance with ASTM C157 and as modified herein.

c. Specimens shall be removed from molds at an age of 23 ± 1 hour after batching and shall be placed immediately in water at 73 ± 3 degrees F.

d. Expansion, expressed as a percentage of original length, shall be measured at age 7 days. This length at age 7 days shall be the base length for drying shrinkage calculations. Specimens shall then be stored immediately in a humidity control room maintained at 73 ± 3 degrees F and 50 ± 4 percent relative humidity for the remainder of the test.

e. Measurement to determine the drying shrinkage, expressed as percentage of base length, shall be made and reported separately for 7, 14, 21 and 28 days of drying after 7 days of moist curing.

f. The average drying shrinkage of each group of the test specimens after 28 days of drying shall not exceed 0.045 percent.

C. Concrete in Direct Contact with Potable Water

1. Cement shall be NSF/ANSI 61 certified. Admixtures shall be NSF/ANSI 61 certified.

2. Aggregates shall be tested and approved by one of the following methods:

a. Provide test cylinders using the proposed mix designs for the concrete that come in direct contact with potable and test as a Barrier Material per Chapter 5 of NSF/ANSI 61 – 2005. Concrete shall be tested for all CA title 22 radionuclides listed in table 64442.

b. Gross Alpha radionuclides testing of the dry aggregates using test procedures acceptable to the California Department of Public Health.

3. Testing shall be conducted by an ANSI or ELAP accredited product certification body for Drinking Water Quality.

4. If NSF/ANSI 61 certified cement and admixtures are not available the following testing procedure shall be required:

a. Provide concrete test cylinders for each mix design that will come in direct contact with potable water to an approved testing laboratory.

b. Concrete specimens shall be soak-tested to verify water quality is in compliance with NSF/ANSI 61-2011 Chapter 5 – Barrier Materials. Concrete specimens shall be tested for the items listed in NSF/ANSI 61 Table 3.1 – Portland and Hydraulic Cements.

c. Testing shall be conducted by an ANSI or ELAP accredited product certification body for Drinking Water Quality.

5. Concrete not meeting NSF/ANSI 61 water quality standards will be rejected.

2.03 TANK CONCRETE

A. Tank Walls: Concrete for tank walls shall have a minimum of 7 sacks of cement per cubic yard, a maximum water cement ratio of 0.42, and a minimum compressive strength of 5,000 psi at 28 days. Concrete for tank wall shall be air-entrained and contain superplasticizer and water-reducing admixtures.

B. All Other Concrete: Concrete for the tank floor, roof, footings, pipe encasement, and all other work shall have a minimum of 6 sacks of cement per cubic yard and have a minimum compressive strength of 4,000 psi at 28 days. Concrete shall have a maximum water cement ratio of 0.45. Superplasticizer and water-reducing admixtures may be incorporated into the floor concrete.

C. Aggregate: The coarse and fine aggregate shall meet the requirements of ASTM C33. Coarse aggregate size for the tank floor and roof shall be No. 57 or No. 67

with 100% passing the 3/4 inch sieve. Coarse aggregate size for the tank wall and all other work shall be No. 57 or No. 67 with 100% passing the 1 inch sieve.

D. Concrete slump - sampled in accordance with ASTM C172 and tested in accordance with ASTM C143 - shall be 3 to 5 inches for all concrete without a superplasticizer and 4 to 8 inches for all concrete with a superplasticizer.

E. Admixtures (other than air-entraining, superplasticizer, shrinkage reducing and water reducing admixtures) will not be permitted unless approved by the Engineer.

F. Polypropylene fibers shall be included in the floor concrete. In lieu of fibers, the Tank Contractor may use a shrinkage compensating admixture such as Eclipse by Grace or Tetraguard by BASF. The admixture shall be added at a minimum rate of 64 fluid ounces per cubic yard of concrete.

G. All concrete used in tank construction shall have a maximum water soluble chloride ion concentration of 0.06 percent by weight of cement.

2.04 WATERSTOPS

A. Waterstops shall be manufactured from virgin polyvinylchloride (PVC) conforming to the Corps of Engineers Specification No. CRD-C572. Waterstops in construction joints shall be flat dumbbell type. Waterstops in expansion joints shall be heavy-duty dumbbell with hollow center bulb. No center bulbs allowed in the waterstop for the vertical wall joints. Waterstops shall be in accordance with the following table:

Location	Length	Vinylex	Greenstreak
Wall to Wall Footing	9”	RB9-38H	735
Vertical Wall Joints	6”	R6-38	679
Floor to Pipe Encasement	6”	RB6-38H	732

B. Other comparable products by Progress Unlimited; or Williams Products are acceptable.

C. Preformed adhesive waterstops where approved for use shall be by Adeka, Inc., Ultraseal; American Colloid Co., Volclay Waterstop-RX or approved equal.

2.05 SEALANTS

A. Sealants shall be as specified in Section 07920.

2.06 BONDING COMPOUNDS

A. Epoxy resin bonding compounds shall be used for wet areas and shall be Master Builder, Concresive Nos. 1001, 1001-LPL or 1180 as applicable; Sika Chemical Corporation, Sikadur 35, Hi-Mod LV, Sikadur 32, Hi-Mod, or Sikadur 31, Hi-Mod Gel as applicable; Burke Company 881 LPL Epoxy; or approved equal.

B. Nonepoxy bonding compounds shall be used for dry areas and shall be Burke Company, Acrylic Bondcrete; Imperial Chemical Industrial, Inc., Thoro System Products, Acryl 60; Thorobond; or equal.

C. Bonding compounds shall be applied in accordance with the manufacturer's instructions.

2.07 CURING MATERIALS

A. Materials for curing concrete as specified herein shall conform to the following requirements and ASTM C 309:

1. Polyethylene sheet for use as concrete curing blanket shall be white, and shall have a nominal thickness of 6 mils. The loss of moisture when determined in accordance with the requirements of ASTM C 156 shall not exceed 0.055 grams per square centimeter of surface.

2. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, having a nominal thickness of 2 mils and permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A (1) (2). The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.

3. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mil thick, white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when determined in accordance with the requirements of ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.

2.08 FORMS

A. Forms shall conform to ACI 347R and shall be designed and constructed to provide the finish specified in Paragraph 3.12.

PART 3 - EXECUTION

3.01 GENERAL

A. The City is defining the quality of cast-in-place concrete by specifying in this part some of the means, methods, techniques, sequences and procedures for construction of cast-in-place concrete. The Contractor, without relinquishing authority and responsibility for supervision and direction of the work, agrees to follow the specified means, methods, techniques, sequences and procedures.

3.02 CONCRETE

A. Concrete shall be truck-mixed, ready-mixed concrete conforming to the applicable portions of ASTM C94. Materials shall be proportioned by weighing.

B. Pozzolan shall be introduced into the mixer with cement and other components of the concrete mix; pozzolan shall not be introduced into a wet mixer ahead of other materials or with mixing water.

C. Water shall be introduced at the time of charging the mixer; additional water may be introduced within 45 minutes from charging the mixer, provided the specified slump is not exceeded; or the Contractor shall be responsible for producing concrete of the specified characteristics. He shall arrange with his testing laboratory for inspection as required to comply with these specifications.

D. Concrete shall be delivered to the site of work and discharge shall be completed within 1-1/2 hours after introduction of the water to the mixture.

E. Each load of ready-mixed concrete delivered to the job site shall be accompanied by a delivery ticket showing the information listed in ASTM C94, Section 16.

F. Any water added to the concrete mixture shall be noted on the delivery ticket.

3.03 CONVEYING AND PLACING CONCRETE

A. Conveying Concrete

1. Concrete shall be conveyed from the mixer to the forms in accordance with ACI 301, Chapter 8. Concrete which has segregated in conveying shall be removed from the site of the work.

B. Placing Concrete

1. General

a. Concrete shall be placed in accordance with ACI 301, Chapter 8, and ACI 304, Chapter 6.

2. Placing Concrete By Pumping

a. Pumped concrete shall be the class and consistency for the use specified herein and in accordance with a design specified under Section 03370.

b. Measure slump at the hose discharge. Slump loss in pumping, measured between the pumping unit inlet hopper and the hose discharge, shall not exceed 1 inch. Before starting each pumping operation, prime the pump and line with a cement slurry to lubricate the system. Cement slurry shall be wasted outside the forms.

3. Placing Concrete in Hot Weather

a. In hot weather (above 85 degrees F), concrete shall be placed in accordance with ACI 305R.

4. Placing Concrete in Cold Weather

a. In cold weather (below 45 degrees F), concrete shall be placed in accordance with ACI 306R.

C. Consolidating Concrete

1. Concrete shall be consolidated in accordance with ACI 301, Chapter 8. Concrete placing shall be suspended if proper consolidation is not being secured until proper consolidation can be achieved.

3.04 FORMWORK

A. Formwork shall conform to Section 03100 and as specified herein.

B. All forms shall be sealed and shall be sufficiently tight to prevent loss of mortar from the concrete. The Contractor shall design and construct all formwork systems to provide only those lines and delineations indicated, unless otherwise approved by the Engineer.

C. Formwork shall be constructed to allow erection in proper sequence and to permit removal without damage to the finished concrete surfaces.

D. The Contractor shall design, construct, and erect all forms for reuse; withdraw projecting nails or other objects from contact surfaces before reusing; clean and completely recondition all forms prior to reuse; and repair any damage to forming

surfaces caused during previous usage. Approval shall be required for each reuse. Formwork with patches or repairs affecting appearance of the concrete surfaces will not be permitted. The Contractor is responsible for the strength and suitability of the formwork.

E. Unless otherwise specified, exposed edges of concrete on the outside of structures and all those in the inside of structures shall be chamfered or beveled at an angle of 45 degrees by using a PVC chamfer strip with nailing leg, such bevel being 3/4-inch on a side.

3.05 CURING AND SEALING

A. General

1. Concrete curing shall be completed by water curing. Repairs or treatment of concrete surfaces shall be coordinated so that interruption of the curing will not be necessary.

2. Concrete surface temperature shall be maintained between 50 degrees F and 80 degrees F for at least 5 days. Curing concrete in hot weather (above 85 degrees F) shall be in accordance with ACI 305 R. Curing concrete in cold weather (below 45 degrees F) shall be in accordance with ACI 306 R.

B. Water Curing

1. When water curing is used, concrete shall be kept wet continuously for a minimum of 7 days after placement. Absorptive mats or fabric may be used to retain moisture during the curing period.

2. Unless otherwise specified, water curing shall be used in hot weather (above 85 degrees F) for water-containment structures. Forms shall be covered and kept moist. The forms shall be loosened, as soon as possible without damage to the concrete, and provisions made for curing water to run down inside them. During form removal, care shall be taken to provide wet cover to newly exposed surfaces. At the end of the specified curing period, the covering shall be left in place without wetting for several days.

3.06 PROTECTION

A. Concrete shall be protected from injurious action by sun, rain, flowing water, frost and mechanical injury, and shall not be allowed to dry out from the time it is placed until the expiration of curing periods.

B. Steel troweled slabs shall be protected with kraft paper, 6 mil thick polyethylene membrane, or other similar waterproof material for at least 2 weeks after placement. Joints between adjacent strips of the paper shall be sealed. Float or broom finished slabs need be protected after curing only in areas subject to damage during construction.

C. Arrangements for covering, insulating, and protecting concrete in cold weather shall be in accordance with ACI 306 R.

3.07 CONSTRUCTION JOINTS

A. General

1. Concrete in each unit of construction shall be placed continuously. Before new concrete is placed on or against concrete which has set, forms shall be retightened and the surface of the set concrete shall be cleaned of foreign matter. Watertight joints shall be provided as specified in Paragraph 3.10.

2. Watertight construction joints, as shown on the Plans, shall be provided in water-containing structures and in below-grade portions of structures.

B. Construction

1. Construction joints shall be formed as specified.

2. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bond. The joint surfaces shall be cleaned of all laitance, loose or defective concrete, foreign material, and roughened to a minimum ¼-inch amplitude.

3. Such cleaning and roughening shall be accomplished by hydroblasting or abrasive blasting (exposing aggregate) followed by thorough washing. All pools of water shall be removed from the surface of construction joints before new concrete is placed.

C. Locations

1. Joints in beams or girders shall be located at or near the midpoint between supports.

2. Joints in the members of a floor system shall be made at or near the center of the span.

3. Joints in walls and columns shall be at the underside of floors, slabs, beams or girders and at the tops of footings or floor slabs. Joints in columns shall be perpendicular to the axis.

4. Slabs shall be cast in monolithic panels. Panels shall be cast in non-adjoining patterns. Minimum lapsed time between placing adjacent panels shall be 24 hours.

5. Vertical and horizontal construction joints shall be grooved at exposed faces. Grooves subjected to wetting or weather shall be caulked with joint sealer as specified.

6. Reinforcing steel shall be continued across construction joints. Girders and floor slabs shall not be constructed over columns or walls until at least one hour has elapsed to allow for shrinkage in the column or wall. No joint will be allowed between a slab and a beam or girder unless otherwise specified. Joints shall be perpendicular to the main reinforcement. Waterstops shall be provided in construction joints at locations as specified in Paragraph 3.10.

3.08 INSERTS AND EMBEDMENTS

A. Inserts

1. Where pipes, castings or conduits are to pass through structures, the Contractor shall place such pipes or castings in the forms before placing the concrete. Horizontal conduits, where shown in structural slabs and beams, shall be placed between the top and bottom layers of reinforcement.

2. Additional reinforcement shall be provided around large openings.

B. Embedments

1. The Contractor shall provide inserts, anchors or other bolts necessary for the attachment of piping, valves, metal parts and equipment. Voids in sleeves, inserts and anchor slots shall be filled temporarily with readily removable material to prevent the entry of concrete into the voids.

3.09 EXPANSION JOINTS

A. Expansion joints shall be as shown. Reinforcement or other embedded metal items bonded to the concrete shall not extend through expansion joints.

3.10 WATERSTOPS

A. Waterstops shall conform to ACI 301, Paragraph 6.3. Waterstops shall be securely held in position during placing of concrete. If, after placing concrete, waterstops are materially out of position or shape, the surrounding concrete shall be removed, the waterstop reset, and concrete replaced.

B. Field splices are acceptable only in straight sections. Crosses, tees, and other shapes shall be fabricated prior to delivery to the site of the work.

3.11 FORMED SURFACE FINISHES

A. Repair of Surface Defects

1. Surface defects, including tie holes, minor honeycombing or otherwise defective concrete shall be repaired in accordance with ACI 301, Chapter 9. Areas to be patched shall be cleaned.

2. Minor honeycombed or otherwise defective areas shall be cut out to solid concrete to a depth of at least 1 inch.

3. The edges of the cut shall be perpendicular to the surface of the concrete.

4. Patches on exposed surfaces shall be finished to match the adjoining surfaces after they have set.

5. Patches shall be cured as specified for the concrete.

6. Finished surfaces shall be protected from stains and abrasions.

7. Finishes shall be equal in workmanship, texture and general appearance to that of the adjacent concrete.

8. Concrete with honeycombing which exposes the reinforcing steel or with defects which affect structural strength shall be corrected.

B. Formed Surface Finishing

1. Formed surfaces shall be finished as soon as practicable after form removal and repair of surface defects.

2. All exposed or interior surfaces shall be finished to remove surface imperfections greater than 3/8 inch in any dimension.

3. Surface imperfections greater than 3/8 inch in any dimension shall be repaired or removed and the affected areas neatly patched.

3.12 SLAB FINISHES

A. General

1. The finishes specified herein include surface finishes, treatments and toppings for floors and slabs. Floors shall be sloped to drain uniformly. Unless otherwise specified, slope shall be minimum 1/8 inch per foot towards nearest drain. Where finish is not specified, floor slabs shall receive steel troweling. Dry cement shall not be used on new concrete surfaces to absorb excess moisture. Edges shall be rounded to a radius of 1/2 inch. Joints shall be grooved to a radius and depth of 1/4 inch each. Uneven-slope tolerance is ¼-inch in 10 feet.

B. Float Finish

1. Float finish shall conform to ACI 301, Section 11.7.2. Floating shall be performed with a hand or power-driven float. Floating of any one area shall be the minimum necessary to produce the finish specified. Floating shall compact and smooth the surface and close any cracks and checking of surfaces. Float finish shall be applied to surfaces of channel and tank bottom slabs and to footings.

C. Steel Trowel Finish

1. Steel trowel finish shall conform to ACI 301, Section 11.7.3. Immediately after final troweling, the surface shall be cured and protected as specified in Paragraphs 3.05 and 3.06. Steel trowel finish shall be provided on floors unless specified otherwise. Surface hardener shall be troweled into the finished surface.

D. Broomed Finish

1. Broomed finish shall conform to ACI 301, Section 11.7.4. Broomed finish shall be provided for walks, tops of tanks, slabs on grade exposed to atmosphere, and where otherwise indicated or specified.

3.13 FIELD SAMPLING AND TESTS

A. General

1. Field sampling and testing shall be performed by the Contractor at an approved testing laboratory. Samples of aggregates and concrete shall be taken at random locations and at such times to represent the quality of the materials and work throughout the project. The laboratory shall provide the necessary labor, materials and facilities for sampling the aggregate and for casting, handling and storing the concrete samples at the site of work.

B. Sampling

1. Aggregates: Three to four samples shall be obtained from batch plant at locations approved by Engineer for each reservoir placement.

2. Concrete: Samples of plastic concrete shall be obtained in accordance with ASTM C172. Samples for pumped concrete shall be taken at the hose discharge point. Samples for other concrete shall be taken at the hopper of concreting equipment or transit mix truck.

C. Concrete Testing

1. For all concrete, provide two sets of five cylinders for the first 50 cubic yards, and one set of five cylinders for every 100 cubic yards thereafter placed in the same day.

2. Slump, air content and temperature testing shall be performed on each truck where cylinders are taken. All concrete testing shall be in accordance with ASTM C31 and C39, at the expense of the Tank Contractor, and shall be conducted by an independent testing agency approved by the Engineer.

3. Standard cylinders shall represent the concrete placed in the forms. One set of four standard cylinders shall be cast for each 100 cubic yards or less or for each 4000 square feet of surface area poured per day. A fifth cylinder shall be cast for every three sets of four cylinders. Casting, handling and curing of cylinders shall be in accordance with ASTM C31. Additional cylinders shall be provided when an error in batching is suspected. For the first 24 hours after casting, the cylinders shall be kept moist in a storage box constructed and located so that its interior air temperature will be between 60 and 80 degrees F. At the end of 24 hours, the cylinders shall be transported to the testing laboratory.

4. Testing of specimens for compressive strength shall be in accordance with ASTM C39. Tests shall be made at 7 and 28 days from time of casting. Two test cylinders from each group of four shall be tested at the end of 7 days and two shall be tested at the end of 28 days. The fifth cylinder shall be tested at the end of 90 days only. A strength test shall consist of the average strength of two cylinders cast from material taken from a single load of concrete.

5. Each strength test result shall be the average of the strengths of two test cylinders at 28 days, except that if one cylinder in a set of two shows evidence of low strength due to improper sampling, casting, handling or curing, the result of the remaining one cylinder shall be used.

6. The average of any three consecutive 28-day strength test results of the cylinders for each structure shall be equal to or greater than the specified strength and not more than 10 percent of the strength test results shall have values less than the specified 28-day strength for the total job concrete. No individual strength test results shall be less than the specified strength by more than 500 pounds per square inch.

7. Certified reports of the test results shall be provided directly to the Engineer. Test reports shall include sufficient information to identify the mix used, the stationing or location of the concrete placement, and the quantity placed. Slump, air content, temperature of concrete, and ambient

temperature shall be noted. The 28-day strength test results shall be evaluated in accordance with ACI 214. Quality control charts showing field test results shall be included with the test results for each major structure. Charts shall be prepared in accordance with ACI 214. Quality control charts shall be maintained throughout the entire job and shall be available for the Engineer's inspection at any time.

8. If the 28-day test results fall below the specified compressive strength for any portion of the work, adjustment in the proportions, water content, or both, shall be made as necessary at the Contractor's expense. Changes and adjustments shall be reported in writing to the Engineer.

9. If compressive test results indicate concrete in place may not meet structural requirements, tests shall be made to determine if the structure or portion thereof is structurally sound. Tests may include, but not be limited to, cores in accordance with ASTM C42 and any other analyses or load tests acceptable to the Engineer. Costs of such tests shall be borne by the Contractor.

10. The slump shall be as specified when measured in accordance with ASTM C143. Samples for slump determination shall be taken from the concrete during placing. Tests shall be made at the beginning of concrete placement operation and at subsequent intervals to insure that the specification requirements are met. Slump tests shall also be performed whenever standard cylinders are cast.

11. Temperature tests shall be made at frequent intervals during hot or cold weather conditions until satisfactory temperature control is established. Whenever standard cylinders are cast, temperature tests shall be performed.

12. Air content shall be as specified when measured in accordance with ASTM C231. Air content shall be measured whenever standard cylinders are cast.

D. Final Laboratory Report

1. A final report, prepared by the Contractor’s testing laboratory, shall be provided at the completion of all concreting.

2. This report shall summarize the findings concerning concrete used in the project and provide totals of concrete used by class and structure.

3. Final quality control charts for compressive strength tests for classes of concrete specified in each major structure shall be included.

4. The report shall also include the concrete batch plant's coefficient of variation and standard deviation results for each class of concrete as determined in accordance with ACI 214.

3.14 CLEANUP

A. Upon completion of the work and prior to final inspection, the Contractor shall clean all concrete surfaces.

B. The cleaning procedures shall be as follows: After sweeping with an ordinary broom to remove the loose dirt, the surface shall be flushed with clean water.

END OF SECTION

SECTION 03370

PRESTRESSED CONCRETE RESERVOIR

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Design and construction of the strand-wrapped prestressed concrete tank construction, furnishing, installation, testing, and disinfection. Tank shall consist of: foundation, concrete floor, cast-in-place concrete corewall, cast-in-place concrete roof, and miscellaneous appurtenances. The core wall shall be post-tensioned vertically with steel rods, prestressed circumferentially with machine wrapped seven-wire galvanized strand, or wire, and protected with shotcrete. Foundation shall be shallow spread footings and conventional slab on grade construction.

B. The prestressed concrete tank shall be designed and constructed in accordance with the provisions of AWWA D110 Standard for Wire Wound and strand Wound Circular Prestressed-Concrete Water Tanks, Type I Cast in Place Concrete with vertical prestressed reinforcement, ACI 350-06, ACI 350.3, and ASCE 7-10.

C. The Tank Contractor shall furnish all labor, materials, tools, and equipment necessary to construct, disinfect and test the circumferentially prestressed concrete tank and appurtenances as indicated on the Plans and as specified including:

1. Concrete encased pipe through floor and all interior piping.
2. Tank overflow and check valve.
3. Concrete encased tank drain complete with valves and piping.
4. Through wall sample lines.
5. Roof vent.
6. Aluminum handrails, interior and exterior ladders, and Saf-T-Climb devices.
7. All roof hatches, aluminum access doors, grating, and cover plates.
8. All roof penetrations and roof downspouts.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals
2. Section 02215 – Tank Drainage Facilities and Waterproofing
3. Section 02620 – Hydraulic Structures Disinfection
4. Section 02770 – Geomembrane
5. Section 03200 – Concrete Reinforcement
6. Section 03300 – Cast-In-Place Concrete For Concrete Tanks
7. Section 05502 – Reservoir Metal Work

1.03 DEFINITIONS

A. The following terms are used in this section:

1. Stressing machine may refer to the automated wrapping machinery used to post-tension strand around the tank circumference or vertical post-tensioning equipment used to post-tension vertical thread bars.

2. Corewall: The wall section that is interior of all circumferential prestressing.

3. Shotcrete: Mortar or concrete that is pneumatically projected at high velocity onto a surface.

4. Rebound: Shotcrete material which ricochets off the receiving surface and falls.

1.04 QUALITY ASSURANCE

A. Basis for Quality

1. Tank construction shall conform to the requirements of AWWA D110 and the following specification paragraphs. Should conflicts occur between the requirements of these specifications and AWWA D110, or ACI 350, the more restrictive requirements shall govern.

B. Tank Contractor

1. The Prestressed Concrete Tank shall be constructed by a single Tank Contractor experienced in the construction of circumferentially prestressed cast-in-place concrete tanks utilizing freed neoprene bearing pad connections at the base of the wall, PVC waterstops, seismic cables spanning the wall to footing joint, and a column supported flat slab roof.

2. The Tank Contractor shall have constructed in its own name a minimum 5 AWWA D110, Type I tanks located within a region with a mapped spectral response acceleration, S_s, of 1.0g or greater in the past 10 years. At least 2 of the above tanks shall have been in successful service for a minimum of five years. Experience gained on work not meeting all of the technical requirements of this specification will not be considered for meeting the necessary experience requirements.

3. The Tank Contractor may subcontract the tank design and tank prestressing operations to a Tank Prestressor who meets the experience requirements of this section for performing tank design and prestressing operations.

4. The Tank Contractor or Tank Contractor's listed Tank Prestressor shall be a specialist in the design and prestressing of prestressed concrete tanks using external circumferential strand wrapping and having at least 10 continuous years' experience in the construction of concrete structures which have been circumferentially prestressed.

5. The Tank Contractor or Tank Contractor's listed Tank Prestressor shall have successfully completed prestressing activities, as specified herein, on a minimum of 10 prestressed concrete tanks, greater than or equal to 2 million gallons in size, used for potable water storage in the last 10 years. At least 5 of the above tanks shall have been in successful service for a minimum of five years. Experience gained on work not

meeting all of the technical requirements of this specification will not be considered for meeting the necessary experience requirements.

6. The superintendent for the Tank Contractor shall have successfully completed construction of a minimum of 3 tanks similar in design as specified and at least two tanks with 2 million gallons in size in the last 5 years. The qualifying construction superintendent shall have been in the direct employment of the qualified Tank Contractor and will be required to be on the project site in responsible charge full time, during all tank construction activities. Experience gained on work not meeting all of the technical requirements of this specification and not performed while in the employment of the Tank Contractor will not be considered for meeting the necessary experience requirements.

7. The Tank Prestressor shall have in its employ a professional design engineer who shall have designed a minimum of 5 prestressed tanks located within a region with a mapped spectral response acceleration, S_s, of 1.0g or greater. The Tank Prestressor shall also have in its employ an ACI 506 certified shotcrete foreman, prestressing foreman, each of whom shall have constructed a minimum of three AWWA D110, Type I tanks.

8. At the time of bid the qualified Tank Prestressor shall have a minimum of two operable strand wrapping and automated shotcrete machines meeting these requirements. Machines under construction shall not be considered in meeting the requirement of having two operable strand wrapping and automated shotcrete machines. Additionally, literature shall be submitted with the bid showing the proposed machinery with the recorders and a typical copy of an actual recording of the applied forces taken from one of the jobs on which such machinery has been used. Any stressing system that will not provide the substantial equivalent of the above requirements will be rejected.

9. The Tank Prestressor shall be responsible to the Tank Contractor for the following phases of work:

    a. Furnish design calculations and drawings stamped by a Professional Engineer who meets the requirements in Section 1.04.B

    b. Furnish seismic base restraint cables for the wall to foundation connection. Furnish seismic shear cans for the wall to flat slab roof connection.

    c. Furnish, stress and pressure grout the vertical prestressing threadbars with epoxy.

    d. Abrasive blast the exterior concrete core wall.

    e. Furnish and install the circumferential prestressing strand.

    f. Apply shotcrete cover coat over application over the strand.

1.05 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of a conflict between the requirements of this section and those of the listed documents, the more restrictive requirements shall govern.

1. ACI 301 Specifications for Structural Concrete
2. ACI 305 Hot Weather Concreting
3. ACI 306 Cold Weather Concreting
4. ACI 309R Guide for Consolidation of Concrete
5. ACI 318 Building Code Requirements for Reinforced Concrete and Commentary
6. ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary
7. ACI 350.3 Seismic Design of Liquid Containing Concrete Structures and Commentary
8. ACI 372R Design and Construction of Circular Wire- and Strand Wrapped Prestressed Concrete Structures
9. ACI 506R Guide to Shotcrete
10. IBC International Building Code
11. ASCE Standard 7-10 Minimum Design Loads for Buildings and Other Structures
12. ASTM A185 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
13. ASTM A416 Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
14. ASTM A475 Standard Specification for Zinc-Coated Steel Wire Strand
15. ASTM A615/A615M Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
16. ASTM A706 Standard Specification for Low-Alloy Deformed and Plain Bars for Concrete Reinforcing
17. ASTM A821 Standard Specification for Steel Wire, Hard Drawn for Prestressing Concrete Tanks
18. ASTM C33 Standard Specification for Concrete Aggregates
19. ASTM C920 Specification for Elastomeric Joint Sealants
20. ASTM D1056 Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber
21. ASTM D2000 Classification System for Rubber Products in Automotive Applications
22. AWWA C652 Standard for Disinfection of Water-Storage Facilities
23. AWWA D110-13 Wire and Strand Wound, Circular, Prestressed Concrete Water Tanks, Type I
24. US Army Corps of Engineers Specification CRD-C-572, Specification for PVC Waterstop
25. NSF/ANSI 61 Drinking Water System Components – Health Effects

1.06 SUBMITTALS

A. Comply with Section 01330 and include the following:

1. Tank Contractor Requirements

   a. Qualifications and experience of the Tank Contractor shall include as a minimum:

   b. Company history, contact person(s), address, and telephone number.

   c. Project references meeting the experience criteria described herein, listing reservoir owner, owner or engineer's contact person, address, telephone number, and year of completion.

   d. The name, work history, and references of the superintendent to be assigned project responsibility by the Tank Contractor and meeting the experience requirements of this specification.

   e. A description and detailed photographs of the proposed equipment to be used to meet the circumferential strand wrapped prestressing and vertical thread bar post-tensioning specifications herein, including the quality assurance measures of continuous force recording of the circumferential strand wrapping and the simultaneous force versus elongation of the vertical thread bar stressing.

2. Shop Drawings

   a. Shop drawings showing all plan views, sections and details of tank construction, pipe penetrations, roof hatches, vents, and all appurtenances. Shop drawings shall be checked by the Tank Contractor prior to submittal.

   b. Shop drawings of the circumferential prestressing wrapping schedule and the intermediate lock-off elevations; sealed by a registered California structural or civil engineer. Shop drawings shall indicate they were checked by the engineer performing the design calculations.

   c. Coating system information.

   d. For each size, heat and reel of prestressing steel supplied, provide certified test reports verifying the supplied strand conforms with applicable ASTM specifications for galvanized coating, materials, strength and yield properties, and permissible dimensional variations. Certified test reports shall include wire strand load-elongation curves.

   e. Certified test reports confirming that the proposed thread bar anchorage system meets the specification requirements.

   f. Detailed installation instructions for all work, including prestressing, abrasive blasting, shotcreting, cleaning, waterproofing, testing, and disinfection. Detailed instructions shall be provided at least 45 days before commencing tank construction.

   g. Strand and vertical thread bar prestressing records

3. Design Submittals

a. Design proportions for all concrete and shotcrete. Concrete strengths of trial mixes.

b. Admixtures to be used in the concrete or shotcrete and their purpose.

c. Reinforcing steel shop drawings showing fabrication and placement.

d. Catalog cuts or shop drawings of all appurtenances, i.e. hatch, vent, ladders, waterstops.

e. Complete shop and erection drawings with dimensions, sizes, and thickness of plates and members; details of welded joints; fabrication and erection of work; including all accessories.

f. The shop drawings shall show concrete foundation thickness and width, number and size of reinforcement, construction and erection details of all accessories and related work, and all other pertinent data concerning the construction of the tank foundation.

g. Horizontal and vertical loadings, erection and settlement tolerances, and maximum loads imparted to the foundation and estimated weight of tank.

h. Structural calculations of the tank and accessory items prepared and signed by a registered civil or structural engineer currently licensed in the State of California. A name and address of the responsible engineer shall appear on the cover of the submitted calculations. The submittal shall include a description of structural design, loading conditions, seismic anchorage calculations and details, and codes used in establishing the allowable stresses and safety factors.

i. Shop drawings showing all plan views, sections and details of tank, pipe penetrations, roof hatches, vents, and all appurtenances. Shop drawings shall be checked by the Tank Contractor prior to submittal.

j. Shop drawings of the circumferential prestressing wrapping schedule and the intermediate lock-off elevations; sealed by a registered California structural or civil engineer. Shop drawings shall indicate they were checked by the engineer performing the design calculations.

k. A description and detailed photographs of the proposed equipment to be used to meet the circumferential strand wrapped prestressing and vertical post-tensioning specifications herein, including the quality assurance measures of force recording of the circumferential wrapping and vertical post-tensioning.

l. For each size, heat and reel of prestressing steel supplied, provide certified test reports verifying the supplied wire conforms with applicable ASTM specifications for materials, strength and yield properties, and permissible dimensional variations. Certified test reports shall include wire load-elongation curves.

m. Certified test reports confirming that the proposed thread bar anchorage system meets the specification requirements.

n. Detailed installation instructions for all work, including prestressing, abrasive blasting, shotcreting, cleaning, waterproofing, testing, and

disinfection. Detailed instructions shall be provided at least 45 days before commencing tank construction.

o. NSF/ANSI 61 certification and water quality testing for concrete in contact with potable water.

1.07 DESIGN CRITERIA

A. Design and construct the prestressed concrete tank in accordance with the provisions of AWWA D110 Standard Type I Prestressed Concrete Water Tanks.

B. Horizontal prestressing shall be continuous. Discontinuous prestressing tendons or wire will not be allowed.

C. The Tank Contractor shall use the following loadings and requirements in the design calculation:

1. Active Capacity: four million gallons.

2. Dimensions: 161 feet inside diameter

3. Dead Load: shall be the estimated weight of all permanent imposed loads. Unit weight of concrete 150 pounds per cubic foot; steel 490 pounds per cubic foot.

4. Live Load: shall be the weight of all the liquid when the tank is filled to overflowing. Overflow is 28 feet above floor at the wall. Unit weight of liquid 62.4 pounds per cubic foot.

5. Total Roof Live Load: 40 psf (Non-reducible)

6. Superimposed Roof Dead Load: 20 psf (for future solar panels)

7. Backfill Pressure: earth loads shall be determined by rational methods of soil mechanics. Backfill pressure (if it exists) shall not be used to reduce the amount of required prestressing.

8. Foundation Loads: As specified in the Geotechnical Report, a circumferential foundation may be designed using a net allowable bearing capacity of 3,200 psf. This value may be increased by one-third for transient loading such as seismic forces.

9. Seismic Design Criteria: Seismic design shall be based on the applicable sections of AWWA D110-13, The California Building Code 2013 (CBC), ASI 350.3, and ASCE 7-10. Impulsive and convective forces shall be calculated utilizing each code and the maximum value of each component shall be used to calculate the total base shear. The wall bearing pads cannot be considered as contributing to the shear resistance during a seismic event.

a. AWWA D110-13 Design Criteria:

1) Importance Factor, I = 1.5

2) Impulsive Structural Coefficient, Ri = 3.5

3) Convective Structural Coefficient, Rc = 1.0

b. ASCE 7-10 Design Criteria:

1) Mapped Spectral Accelerations for Short Periods; Ss = 0.593

2) Mapped Spectral Accelerations for 1-Second Period; S1 = 0.241

3) Site Class D

4) Response Modification Factor, R = 3.25

5) Long-period Transition Period; TL = 12.0

6) Importance Factor, Ip = 1.50

c. Sloshing Height: Shall be calculated using both ASCE 7 and AWWA D110 and the more conservative value utilized. The effects of the “sloshing wave” shall be accounted for by increasing the freeboard between the normal operating surface and the underside of the roof, or a roof capable of resisting the uplift of such a wave designed. Any confined portion of the convective (sloshing) mass shall be calculated and applied as an additional impulsive mass. A minimum freeboard from the overflow to the top of wall shall be 24-inches.

d. Dynamic Effects of Backfill: Seismic design shall consider the additive effects of the dynamic effects of the tank backfill. The effect shall be calculated as specified in the Geotechnical Report.

e. Seismic Cable Design:

1) The seismic cables shall be designed for the total base shear obtained from the maximum values of impulsive and convective components and the dynamic effects of backfill. The maximum allowable seismic cable stress = 0.75 f_{pu}

2) For the total base shear obtained from the loading conditions of ASCE 7 that incorporate an overstrength factor (Omega Factor), the allowable seismic cable stress shall be increased by 20%. The Omega factor shall be 2.0 for all loading cases.

f. Wind Loads: shall be as required by ASCE 7

g. Vent Capacity Requirements:

1) Maximum fill rate: 8,000 gpm

2) Maximum draw down rate: 10,000 gpm

h. Overflow Design Capacity: 8,000 gpm

D. The Tank Contractor shall design the tank cast-in-place core wall based on the following design criteria and requirements:

1. The prestressed tank wall shall be considered as a cylindrical shell with partial edge restraint.

2. Minimum cast-in-place tank core wall thickness shall be 10 inches. The core wall is that area of the wall interior to all circumferential prestressing.

3. The minimum final shotcrete cover layer over the circumferential prestressing strand shall be 1.5 inches for area exposed to weather and 2 inches for area in contact with soil.

4. The cast-in-place tank core wall shall be prestressed vertically with high-strength threadbars conforming to ACI 350 and material requirements of ASTM A722. All vertical prestressing of tank walls shall be done with 1.25 inches or 1.375 inches diameter threadbars, with screw nut anchors,

conforming to the material requirements in these Specifications. The maximum horizontal distance between any two vertical prestressing threadbars shall not exceed 50 inches.

5. The inside face of the tank core wall shall be further reinforced with full height no. 5 bars and spaced, on average, no farther apart than 18 inches on centers.

6. All reinforcing steel in the cast-in-place concrete wall shall be 1.5 inches minimum from the inside face of wall.

7. The cast-in-place tank core wall shall be supported by solid neoprene bearing pads allowing free radial movement of the wall relative to the wall footing. If required by design, the walls shall be tied circumferentially to the wall footing with seismic cables consisting of hot-dip galvanized strands encased in closed cell sponge rubber sleeves. A PVC waterstop connection shall be provided between wall and wall footing.

8. The minimum pad thickness under the cast-in-place tank core wall shall be 0.5 inch.

9. The minimum total neoprene bearing pad width under cast-in-place tank core wall shall be 2.5 inches.

10. All neoprene or natural rubber pad sections shall be based on continuous loading values not to exceed those allowed in the neoprene design manual.

11. No reduction in ring compression or tension in the cast-in-place tank core wall will be taken due to restraint at the bottom.

12. The long-term prestressing losses caused by shrinkage, creep, and relaxation in the prestressed reinforcement of the cast-in-place tank core wall shall not be assumed less than 25,000 psi.

13. Friction between wall and rubber bearing pads and lateral soil pressures shall not be considered in resisting seismically generated shear forces between the wall footing and the wall between. These forces shall be resisted by positive connections taking the loads in the tangential direction only and at the same time allowing free radial motion of the wall.

14. Tank wall systems based on jack-operated cable or rod type tendons, involving the circumferential movement of prestressing steel relative to the wall surface shall not be considered. Circumferential systems relying on strand cables placed inside of ducts (cast in the core wall) or manually around the exterior will not be accepted. Circumferential systems that utilize wire wrapping (in lieu of strand wrapping) will not be accepted.

15. Shotcrete, precast concrete or other alternative core walls are not permitted.

E. Floor Slab

1. The floor slab shall be designed as a membrane floor not less than 6.5 inches thick and shall be placed monolithically. No construction joints will be allowed unless otherwise approved by the Engineer. Minimum ratio of floor reinforcement area to concrete area shall be 0.8 percent for tanks with diameter greater than 150 feet.

2. Floor slab shall be designed to accommodate 3/4-inch differential settlement gradually across the tank radius.

3. Provide floor design to accommodate additional loads imposed during construction.

4. Wall footings may be above or below floor grade, but shall be placed monolithically with the floor. The minimum wall footing thickness shall be 18 inches.

5. Minimum concrete cover for the floor slab shall be in accordance with Appendix H in ACI 350.06 paragraph H.4.4 and shall be no less than 2” to the tank interior and 3” to the tank subgrade.

6. Floor slab to foundation transition shall be designed to resist additional vertical tension for seismic effects.

7. Alternative floor slab designs are subject to Engineer review and approval.

F. Flat Roof Construction

1. The roof shall be cast-in-place concrete with a minimum thickness of 9 inches. The minimum top and bottom cover to all reinforcing shall be 2 inches.

2. The roof shall be of flat-slab two-way action design, constructed of cast-in-place concrete supported by interior columns at 25 foot maximum spacing.

3. Columns shall be a minimum of 24 inches in diameter, spirally reinforced in accordance with section 7.10.4 of ACI 350, and detailed with a pin base connection to avoid inducing bending moment in floor slab or footings.

4. Non-prestressed steel-reinforced concrete flat slabs and columns shall conform to the applicable requirements of ACI 350, including sanitary durability coefficients with special attention to crack control.

5. The design shall provide a weather-tight roof to minimize cracking and to prevent leakage and contamination of the contents. Consideration shall be given for the exposure conditions. Reinforcement of concrete slabs shall also be provided to resist temperature stresses.

6. Roof shall be designed to have a minimum of 1.5% slope and provide adequate drainage.

1.08 DESIGN RESPONSIBILITY

A. The Contractor shall provide certification, signed by a California Registered Civil or Structural Engineer, stating that all members, elements and connections of the tank are designed to withstand required loads and forces. Certification shall list the codes and specifications to which structural design conforms. Tank construction drawings and all design calculations, noted under Submittals of these specifications, shall bear the stamp of a California Registered Civil or Structural Engineer.

1.09 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Provide written certification that shipped materials have been inspected prior to shipment and contain no apparent defects.

B. Prestressing steel shall be adequately packaged for protection against intrusion of atmospheric or other chemical contaminants, and physical damage and corrosion during shipping and storage.

C. Prestressing steel that has sustained rust or other physical damage will be rejected.

D. All materials and prestressing material delivered to the job site shall be stored off the ground on planks, supported by 4-inch by 4-inch or larger timber. Materials shall be enclosed with polyethylene or sisalkraft paper to prevent the entrance of moisture from the bottom and other areas.

1.10 GUARANTEE

A. The Tank Contractor shall guarantee the structure against defective materials or workmanship for a period of two years from the date of completion. If any materials or workmanship prove to be defective within two years, they shall be replaced or repaired by the Tank Contractor at the Tank Contractor's expense.

PART 2 - PRODUCTS

2.01 CONCRETE

A. Concrete for tan construction shall conform to Section 03300 except as modified in this specification section.

B. Concrete in contact with potable water shall be water quality tested per 03300 Article 2.02. C.

2.02 PRESTRESSING MATERIALS

A. Seven-Wire Strand

1. Hot-dip galvanized seven-wire strand used for circumferential prestressing shall meet the following minimum requirements:

a. Nominal strand diameter, inches: 3/8

b. Nominal area after galvanizing, sq. in: 0.089

c. Nominal weight/1,000 LF, pounds: 303

d. Pitch (strand diameter): 12-16

e. Minimum tensile strength after galvanizing, psi: 240,000

f. Minimum yield strength @ 1 percent extension, psi: 180,000

g. Minimum elongation in 24 inches at fracture, percent: 4.5

h. Minimum weight of zinc coating, oz/sq. ft.: 0.85

2. Seven-wire strand shall be manufactured in accordance with ASTM A416 with zinc coating meeting the requirements of ASTM A641 or ASTM A475.

3. Splices for horizontal prestressing shall be ferrous material compatible with the reinforcement and shall develop the full strength of the strand. Strand splices and anchorage accessories shall not nick or otherwise damage the prestressing.

B. High-Strength Thread Bars

1. Deformations of the thread bars shall form a screw-thread suitable for mechanically coupling lengths of thread bar and for positive attachment of anchor assemblies.

2. Deformation shall conform to ASTM A722, Type II requirements and shall be uniform such that any length of bar may be cut at any point and the internal threads of a coupling designated for that size of bar can be freely screwed on the bar. The bars and their deformations shall be hot rolled.

3. Tensile and physical properties shall meet the following requirements with bars being manufactured in accordance with ASTM A722, Type II:

   a. Nominal diameter, inches: 1.25-1.375

   b. Minimum tensile force, kips (min): 187-237

   c. Yield force at 0.2 percent offset, kips (min): 150-190

   d. Elongation in 20 bar (diameter), percent (min): 4-4

   e. Nominal cross-sectional area, sq. in.: 1.245-1.577

   f. Nominal bar weight, lb/ft.: 4.39-5.56

   g. Minimum Ultimate Strength, ksi: 150-150

4. Thread bars with cold-rolled threads or with quenched or tempered steels will not be permitted. Maximum carbon content shall not exceed 0.55 percent. Only manufacturers with at least 5 years (under their current name) in the manufacturing of post-tensioning material will be accepted.

C. Anchorages for Vertical Post-Tensioned Thread Bars

1. All post-tensioned prestressing shall be secured at the ends by means of approved permanent anchoring devices, which shall hold the prestressing steel at a force not less than 95 percent of the guaranteed minimum tensile strength of the prestressing steel.

2. The load from the vertical prestressing anchoring device shall be distributed to the concrete through steel bearing plates and shall not exceed the values specified by the Post-Tensioning Institute (PTI), Guide Specifications, Paragraph 3.1.7.

3. All vertical prestressing anchor plate dimensions, all dimensions relating to the conical hole in the top and bottom of the bearing plate, all steel tubing attached to the top bearing plate, and the threadbar spacing shall strictly conform to the details shown on the drawings.

4. Fully-threaded anchor connections shall be used at both ends of the vertical prestressing bar, which shall incorporate a spherical-shaped bearing surface to match the conical surface in the bearing plate.

5. The contact point of the vertical prestressing bearing surface to conical hole shall be approximately ¼ inch to ½ inch below the bearing plate surface.

6. Wedge anchors shall not be used for permanent anchor hardware.

D. Testing of Prestressing Material

1. Provide mill test certificates in accordance with Paragraph 1.04 for each size, heat, or reel of prestressing steel furnished.

2. Prior to the preparation of shop drawings and installation of vertical thread bars, provide proof that the thread bar anchorage system meets the requirements of these specifications.

3. Before any stressing operation may be started, the Tank Contractor shall calibrate all recording equipment at an approved testing laboratory to the satisfaction of the Engineer.

4. All continuous force readings for either the vertical or the circumferential prestressing operations shall be developed with electronic (or the substantial equivalent) force (strain gage method) sensing transducers, all having a maximum nonlinearity error of +/- 0.5 percent and a maximum hysteresis error of +/- 0.25 percent.

E. Anchor Pockets for Vertical Thread Bars

1. Anchor pockets for vertical prestressing thread bars shall consist of steel cans, hot-dip galvanized after cutting and subsequently welded to the top bearing plate.

2. Anchor pockets shall be adequately sealed from moisture and concrete intrusion by wooden lids and 2-inch wide plastic adhesive tape.

3. Anchor pockets for vertical prestressing thread bars shall have adequate provisions for flushing of ducts with water during concrete placement.

F. Ducts for Vertical Thread Bars

1. Duct enclosures for vertical prestressing steel shall be standard 1.25 inch or 1.50 inch diameter Class 160 or Class 200 PVC pipe, respectively. Threaded hose connections shall be provided at the top of each duct for water flushing. All ducts shall be provided with expandable valves to facilitate the injection of epoxy after prestressing.

G. Epoxy Grout for Vertical Thread Bars

1. The vertical thread bar system shall offer complete two-part epoxy protection of the prestressing steel inside ducting and anchors. Portland cement grout will not be accepted.

2.03 EARTHQUAKE CABLES

A. The tank designer shall use base restraint cables to resist earthquake loads. Seismic base restraint cables shall be hot-dipped galvanized seven-wire strand and shall be manufactured in accordance with ASTM A416 prior to galvanizing, and ASTM A475 after galvanizing. Only seven-wire strand will be allowed. Single wire will not be allowed.

B. Earthquake cables shall be hot-dip galvanized seven-wire strand and shall have a nominal strand diameter of 0.375 in, 0.50 in or 0.60 in. 0.375 inch diameter strand shall have an MUS after galvanization of 21.36 kips and a min. yield at 1% extension of 15.60 ksi. 0.50 inch diameter strand shall have a MUS after galvanization of 38.25 kips and a min. yield at 1% extension of 28.00 ksi. 0.60 inch diameter strand shall have a MUS after galvanization of 54.20 kips and

a min. yield at 1% extension of 40.70 ksi. All strands shall have a minimum of weight of Zinc Coating of 0.85 oz./sq-ft.

C. Neoprene sleeves for base restraint cables shall be closed-cell conforming to ASTM D1056, Type 2, Class A, and Grade 3. The sleeves shall have a compression deflection limited to 25% at 9 to 13 psi, hardness of 60 to 80 durometer, a minimum tensile strength of 115 psi, a minimum elongation of 180%, and a maximum compressive set of 35%.

2.04 SHOTCRETE

A. General

1. Shotcrete shall conform to ACI Standard 506, except as modified herein. Shotcrete shall be fibrous reinforced with polypropylene fiber, 1.5 pounds per cubic yard of mortar. All shotcrete shall have a maximum water-cement ratio of 0.42.

2. Rebound materials shall not be reused in any form for shotcrete.

3. Minimum compressive strength of shotcrete shall be 5,000 psi at 28 days.

B. Cement

1. Portland cement for the shotcrete operation shall be in accordance with Section 03300.

2. Shotcrete used for covering prestressed strand shall consist of not more than three parts sand to one part Portland cement by weight. Additional coats of shotcrete shall consist of not more than four parts sand to one part Portland cement by weight. All shotcrete used in the tank construction shall have a maximum water soluble chloride ion concentration of 0.06 percent by weight of cement.

C. Fine Aggregates

1. Fine aggregates shall meet the general requirements specified in Section 03300.

2. A well-graded coarse sand shall be used for all shotcrete applications.

3. Coarse sand shall generally consist of the following gradation:

Sieve Size	Percent Passing by Weight
3/8-inch	100
No. 4	95 – 100
No. 8	80 – 100
No. 16	50 – 85
No. 30	25 – 60
No. 50	10 – 30
No. 100	2 – 10
The fineness modulus shall be between 2.7 and 3.00.	

D. Polypropylene fibers shall be included in the shotcrete used for the finish covercoat. Fibers shall be Fibercast 500 by Propex, or equal. Fiber length shall be 1/4 inch. The amount of the fibers added to the shotcrete used for the finish covercoat shall

conform to the manufacturer's recommendations. Fly ash may be incorporated into the finish covercoat. Fly ash shall conform to ASTM C618, Type F.

2.05 REINFORCING STEEL

A. Reinforcing steel shall be new billet steel Grade 60 in accordance with Section 03200. Welded wire fabric shall conform to ASTM A185.

B. All reinforcing to be welded shall be ASTM A706.

C. Reinforcing steel shall be accurately fabricated and shall be free from loose rust, scale, and contaminants which reduce bond.

D. Reinforcing steel shall be accurately positioned on supports, spacers, hangers, or other reinforcements and shall be secured in place with wire ties or suitable clips. Rebar chair supports may be either steel or plastic.

E. Circumferential reinforcing shall be continuous through the vertical wall joints. Continuous reinforcing through floor or roof joints shall have a Class 1 galvanized coating without chromate or epoxy coating.

2.06 ELASTOMERIC MATERIALS

A. Waterstops shall be manufactured from virgin polyvinyl chloride (PVC) meeting the requirements of the Corps of Engineers Specification CRD-C 572 and in accordance with Section 03300. Splices shall be made in accordance with the manufacturer's recommendations subject to the approval of the Engineer.

B. Bearing pads shall be natural rubber or neoprene. Neoprene bearing pads shall conform to ASTM D2000 M2BC 414A 14C12 F17, homogeneous. Natural rubber bearing pads shall contain only virgin natural polyisoprene as the raw polymer and the physical properties shall comply with ASTM D2000 Line Call-Out M 4 AA 414 A1 3. Neoprene bearing pads shall have a hardness of 40 durometer, a minimum tensile strength of 1500 psi, a minimum elongation of 500 percent, and a maximum compressive set of 50 percent. Pads shall meet the requirements of ASTM D2000 Line Call-Out M 2 BC 410 A1 4 B14 for 40 durometer material.

C. Sponge filler shall be closed-cell neoprene or rubber conforming to ASTM D1056, Type 2, Class A, and Grade 1. Compression deflection limited to 25 percent at 2 to 5 psi.

D. Polysulfide or polyurethane sealant will be a two or three component elastomeric compound meeting the requirements of ASTM C920. Sealants must have permanent characteristics of bond to metal surfaces, flexibility, and resistance to extrusion due to hydrostatic pressure. Air cured sealants shall not be used.

2.07 APPURTENANCES

A. The Tank Contractor shall provide and install all appurtenances as shown on the Plans and as specified in Section 05502.

PART 3 - EXECUTION

3.01 GENERAL

A. The Tank Contractor, without relinquishing authority and responsibility for supervision and direction of the work, agrees to follow the specified means, methods, techniques, sequences, and procedures specified below.

3.02 SUPERVISION

A. Tank Contractor shall provide a full-time site superintendent during tank construction.

3.03 FLOOR SLAB

A. The floor slab shall be designed as a membrane floor not less than 6.5 inches thick and shall be placed monolithically. No construction joints will be allowed unless otherwise approved by the Engineer. Minimum ratio of floor reinforcement area to concrete area shall be 0.8 percent. Wall footings shall be placed monolithically with the floor.

B. A 30 mil PVC moisture barrier shall be placed on top of the compacted base and underneath the leveling base material in accordance with Section 02770. Stakes shall not be driven through the 30 mil liner. Prior to placing the floor reinforcing, a 6 mil poly curing barrier shall be placed over and cover rock base. Barrier shall be lapped 6 inches minimum but need not be sealed or protected from punctures.

C. Prior to placement of the floor concrete, all piping that penetrates the floor shall be set and encased in concrete.

D. The vertical waterstop shall be placed and supported so that the bottom of the center bulb is at the elevation of the top of the footing. The waterstop shall be supported without puncturing any portion of the waterstop unless it is manufactured with holes for tying. The waterstop shall be spliced using a thermostatically controlled sealing iron and each splice shall be successfully spark tested prior to encasement in concrete.

E. There shall be no construction joints in the floor or between the floor and footing. Floors over 30,000 sq. ft. in surface area may, at the option of the Tank Contractor, have one or more construction joints. Such construction joints shall be approved by the Engineer prior to placement.

F. The floor shall be cured by flooding with water, and shall remain saturated for a minimum of seven days. Alternatively, the Contractor may use water saturated covers. Maintain cover and floor in saturated condition for a minimum of seven days.

3.04 CAST-IN-PLACE CORE WALL

A. The wall shall have a minimum thickness of 10 inches and be poured without any horizontal joints. The wall design shall be such that sections can be poured full height without creating horizontal cold joints.

B. Pouring of walls shall be done only through pour openings on one side of the wall. The pour openings size shall be 18 inches and the horizontal distance between such openings shall not exceed 96 inches nor shall the distance between the pour openings and the bulkhead for the vertical joints exceed 36 inches.

C. Under no circumstances shall the forming be such that the drop distance in the concrete form exceeds 8 feet in any one place.

D. The out of round tolerance is ¾ inch in fifty feet and 3/8 inch in 10 feet from the curvature specified at any point on the wall.

E. The maximum permissible variation in the vertical alignment from the bottom to the top of the wall is plus or minus 3/8 inch.

F. The allowable tolerance in the average wall thickness for poured walls shall not vary more than 1/8 inch in either direction. All transitions from plus to minus shall be gradual even and smooth and without abrupt changes in the surface.

G. Removal of all forms shall not be started any sooner than 12 hours of time with the ambient air temperature above 50 degrees after completion of the wall pour.

3.05 CAST-IN-PLACE ROOF

A. Roof decking shall not vary from slope shown more than 1/4 inch in 10 feet or 1/2 inch maximum in 20 feet or more.

B. A curing compound shall be applied to the roof in accordance with the manufacturer's recommendations. Water curing may be used in conjunction with the curing compound.

3.06 CONCRETE

A. General

1. All concrete shall be conveyed, placed, finished, cured, and tested in accordance with Section 03300.

B. Weather Limitations

1. Unless specifically authorized in writing by the Engineer, concrete shall not be placed without special protection during cold weather when the ambient temperature is below 35 degrees Fahrenheit and when the concrete is likely to be subjected to freezing temperatures before initial set has occurred and the concrete strength has reached 500 psi. Concrete shall be protected in accordance with ACI 306. The temperature of the concrete shall be maintained in accordance with the requirements of ACI 301 and ACI 306. All methods and equipment for heating and for protecting concrete in place shall be subject to the approval of the Engineer.

2. During hot weather, concreting shall be in accordance with the requirements of ACI 305.

3. Placement of concrete during periods of low humidity (below 50 percent) shall be avoided when feasible and economically possible, particularly when large surface areas are to be finished. In any event, surfaces exposed to drying wind shall be covered with polyethylene sheets immediately after finishing, or flooded with water, or shall be water cured continuously from the time the concrete has taken initial set.

C. Testing

1. The strengths specified for the design mix shall be verified by accomplished by testing standard cylinders of concrete samples taken at the job site.

3.07 EARTHQUAKE CABLES

A. Where required by the shop drawings, cables shall be prebent before placement in the wall and wall footings. Shop drawings shall detail how cables are tied to

the lower horizontal circumferential tie-bar on the vertical prestress thread bars and radial footing bars.

3.08 PRESTRESSING

A. Circumferential Prestressing Equipment

1. The circumferential stressing system shall produce a continuously, electronically (or substantial equivalent) monitored permanent stress or force recording along the full length of the strand as it is being applied. The stress variation in any strand at any point around the circumference shall not be greater than plus or minus 1.5 percent of the ultimate strength of the steel. In addition to this recording, any system which deflects the tensioned strand between the tensioning device and the wall after it has left the tensioning device shall provide a similar continuously monitored stress or force record along the full length of the strand as it is being applied to the wall. These recordings shall show that either before or after deflection that the stress variation in any strand at any point around the circumference shall not fluctuate more than plus or minus 1.5 percent of the ultimate strength of the steel. Manually recorded force readings will not be accepted. To ensure the effectiveness, accuracy and suitability of this quality assurance measure, the necessary recording equipment shall have previously been used on the tanks required to meet the experience requirements of these Specifications.

2. The prestressing system shall be capable of applying a continuous wrapped force at any point around the circumference within the specified tolerances. Circumferential stressing systems based on jack-operated cable or rod-type tendons will not be allowed.

B. Circumferential Prestressing Application

1. Wrapped strand shall be anchored to the wall at least once for every coil or reel.

2. Permanently anchoring one strand to a previously wrapped strand will not be permitted.

3. Wrapped strand ends shall be joined by suitable splicing methods that shall develop 90 percent of the full strength of the strand.

4. Use of different alloys in the splicing material will not be permitted.

5. The clear spacing between any two wrapped strands in the vertical direction shall be 1.5 strand diameters or 3/8 inch, whichever is larger.

6. All wrapped strands not meeting the spacing requirements shall be spread by approved methods or shall otherwise be removed.

7. The band of prestressing normally required over the height of an opening shall be displaced into circumferential bands immediately above and below the opening to maintain the required prestressing force. Bundling of wires shall be prohibited.

C. Vertical Prestressing Equipment

1. The Tank Contractor shall provide a continuously, electronically (or substantial equivalent), monitored permanent force elongation record from zero to full force at the final lock-off for all of the vertical prestressing

work. To ensure the effectiveness, accuracy and suitability of this quality assurance measure, the necessary recording equipment shall have previously been used on the tanks required to meet the experience requirements of these Specifications.

2. The ordinate of the permanent recording shall show the elongation in inches and the abscissa shall show the force in pounds or kips.

3. Manually recorded force and elongation readings will not be accepted.

4. The vertical thread bar stressing machinery shall have automatic electronic tensioning cut-off devices or equivalent means to ensure that the specified force and elongation is not exceeded at any time during any thread bar stressing operation.

5. The force readings at the stressed bar ends, immediately after lock-off, for any stressing operation, on any thread bar, shall not fluctuate more than plus or minus 1.5 percent (of the minimum ultimate strength of the steel) from the desired average force setting.

6. The applied force, immediately after lock-off for the final stressing operation on any thread bar, shall be no less than 72 percent and the applied force before lock-off shall be no greater than 75 percent of the minimum ultimate strength of the steel.

D. Vertical Prestressing Application

1. All permanent anchor hardware shall have a ball-shaped threaded nut that can be screwed down on to a matching cone-shaped bearing surface in the bearing plate after the desired tension on the anchor hardware and/or prestressing steel has been applied.

2. All ducts shall be clean and free of water and deleterious materials that would impair bonding of the grout or interfere with grouting procedures.

3. Epoxy injection pipes shall be fitted with positive mechanical shutoff valves, which shall not be removed within the first 24 hours. Epoxy injection of thread bars shall be started at the lowest grout connection. Each vertical thread bar duct shall be pumped until the entire nut at the top anchor has been covered. Pea gravel and/or silica sand may be placed in the thread bar can as a filler prior to or after epoxy pumping.

4. In cold weather, and especially during frosts, special precautions shall be taken to prevent grout freezing. If the grouting procedure cannot be postponed, the wall temperature shall be kept above the freezing point with hot blankets or other suitable means.

5. After the vertical stressing and grouting operation, all anchor pocket areas above the anchor nuts shall be dry packed with a 1 cement to 2 sand mortar mix immediately after the epoxy coating on the inside can surface has become tacky. As an alternate to dry packing, the metal may be filled with concrete aggregates and epoxy.

6. The inside surfaces of metal cans shall be coated with a 2-part epoxy. Dry packing shall not proceed until the epoxy coat has become tacky. The dry pack surface shall be finished flush with the adjoining concrete surface.

7. Damaged PVC tubing shall be replaced unless repairs are otherwise approved by the Engineer.

8. Vertical prestressing thread bars shall be accurately placed at the locations shown on the shop drawings and shall be securely fastened in place to reinforcing steel and form ties to prevent movement during placement of concrete.

9. All vertical thread bars shall be flushed with water from the top immediately upon completion of the concrete vibrating operation. Should a thread bar duct not flush properly, the Engineer shall be notified immediately.

10. Placing of vertical thread bars shall be done to proper locations, elevations and alignments, with a maximum tolerance of plus or minus 1/4 inch.

11. All vertical thread bars shall be properly tied at the anchor plates and shall be tied with No. 4 bars at 2-foot intervals between the anchor plates, unless otherwise shown on the shop drawings.

12. Anchor plates shall be installed at right angles to the thread bar alignment near the anchor. The maximum permissible misalignment of anchor plate to thread bar alignment is plus or minus 2.5 degrees.

13. Unless indicated otherwise on the shop drawings, the minimum concrete cover around metal anchor pockets and bearing plates shall be 1.5 inches.

14. The clearance between bottom anchor plate and waterstop in tank walls shall be no less than 2 inches or more than 4 inches.

E. Circumferential and Vertical Prestressing Operations

1. The initial electronically (or substantial equivalent) recorded steel stress for the circumferential prestressing shall not exceed 71.5 percent, nor shall it be less than 68.5 percent of the guaranteed minimum ultimate strength (M.U.S.) of the steel at any time during and after stressing.

2. An automatic, continuously electronically (or substantial equivalent) monitored permanent recording of the applied force, at any point on the strand, at any point on and around the tank wall, shall be made during the entire circumferential prestressing application. All such recordings shall be based on a continuous sensing of the applied force on the strand between the tensioning drum and the wall when, and as, the strand is being wrapped and laid on the wall.

3. The force setting on wrapping and thread bar stressing machinery shall be such that the applied forces fall within the specified minimum or maximum stress or force limitations; the force setting shall be corrected immediately when the applied force falls outside the required force tolerance limitations.

4. In the event that the stressing machinery is incapable of holding the applied forces within the specified stress or force limitations, the Engineer will order, at Tank Contractor's expense, the removal and replacement of such machinery in favor of a different stressing process capable of maintaining such tolerance requirements.

5. The continuous, force application recording chart made during the wrapping application shall become the property of the City.

6. Manual, individual or intermittent force readings taken on wrapped strand in full bodily contact with the wall will not be accepted. Force readings based on anything other than instantaneous force readings, as the strand is being tensioned, and wrapped around the tank, will not be accepted.

7. An automatic, continuously electronically (or substantial equivalent) monitored and simultaneously recorded force-elongation reading shall be made for each vertical stressing application.

8. The force-elongation reading shall represent the true relationship between the elongation at any given point of the vertical stressing operation and the applied force on the prestressing steel at that same point.

9. The force-elongation relationship shall be constantly maintained from the beginning, starting with the removal of the slack to the point of lock-off and complete release of the force on the vertical prestressing steel after retraction of the stressing piston or equivalent stressing device.

10. All electronically produced force-elongation readings during the vertical thread bar stressing operations become the property of the City.

11. The prestressing force for vertical thread bars shall not be applied until the concrete compressive strength in the wall has reached 4,000 psi.

12. Wrapping may start after the completion of prestressing force for vertical thread bars.

13. If gaps exceeding 3/8 inch between the shotcrete and the wrapped strand occur, wrapping shall be discontinued and the wall shall be built up with shotcrete to provide the proper curvature. Alternately, if approved by the Engineer, the gaps may be dry-packed after wrapping is completed and before shotcreting is started.

14. Wrapping over intermediate shotcrete coats or built-up shotcrete areas may commence 12 hours after the shotcrete has been applied, or when the shotcrete has reached a strength of 250 psi, whichever duration is longest.

15. The temperature of the prestressed material during application shall not be allowed to increase by more than 50 degrees at any time during such application due to the stressing technique.

16. All thread bar ducting and anchors shall be pressure grouted with an approved 2 part water insensitive epoxy and approved epoxy grouting equipment.

3.09 ABRASIVE BLASTING

A. Exterior surfaces of the concrete corewall which will receive strandwrapping shall be abrasive blasted, regardless of the forming method used, by a mechanical etching or shotblast system combined with a vacuum recovery system, or a waterblasting system. Systems that have not been used successfully in the past to prepare circular tank wall surfaces for shotcreting and strandwrapping or

systems which rely on sandblasting or steel shot without a vacuum system will not be allowed.

B. The surface shall be abrasive blasted sufficiently to remove all laitance, form oil or other type of coatings. The surface shall be cut to a minimum CSP5 profile, as established by the International Concrete Repair Institute (ICRI), over a minimum of 90 percent of the surface being prepared as measured over any one foot square area. The prestressing operator who is performing the abrasive blasting shall make available to the inspector ICRI sample coupons to assist in evaluating the abrasive cut.

C. Material from blasting operation shall be captured, contained, and collected by impermeable fabric over aggregate base at tank foundation.

3.10 SHOTCRETING

A. Shotcrete Equipment

1. Delivery Equipment: The delivery equipment shall be of a design and size which has given satisfactory results in similar previous work.
2. The equipment shall be capable of discharging mixed materials into the hose under close control and shall be able to deliver a continuous smooth stream of uniformly mixed material at the proper velocity to the discharge nozzle, free from slugs of any kind.
3. The nozzle shall be of a design and size that will ensure a smooth and uninterrupted flow of materials.
4. Delivery equipment shall be thoroughly cleaned at the end of each shift.
5. Air Supply: Minimum compressor air capacity shall be 400 cfm at the shotcrete equipment nozzle.

B. Shotcrete Application Process

1. Nozzles shall be mounted on power-driven machinery enabling the nozzle to travel parallel to the surface to be sprayed at a uniform linear or directional speed.
2. The nozzle shall be kept at a uniform constant distance from the surface, always ensuring a right angle spray of the material to the surface.
3. Shotcrete shall be applied by an ACI 506 certified nozzleman. Documentation of certification shall be provided to the Engineer prior to applying any shotcrete. Total Cover coat thickness shall be controlled by shooting guide wires unless applied with automated equipment.
4. Shotcrete shall be applied under the wet mix process only.
5. Hand-operated nozzles and shotcreting operations dependent on the performance of the nozzle operator will not be accepted except where additional shotcrete is needed to correct flat areas or for architectural surface treatments.
6. Grout materials shall be delivered to the job site in ready-mix trucks from approved batching plants. However, job mixing will be accepted provided automatic weigh batch plants are used.

7. The sand, cement and water shall be premixed before being pumped through a 2-inch minimum diameter hose by specially designed mortar pumps.

8. High velocity impact shall be developed pneumatically by injecting compressed air at the nozzle.

9. To ensure the effectiveness, accuracy and suitability of this quality assurance measure, the necessary shotcreting equipment shall have previously been used on the tanks required to meet the experience requirements of these Specifications.

C. Shotcrete Placing and Finishing

1. General:

   a. Shotcrete shall be applied in a steady, uninterrupted flow.

   b. Should the flow become intermittent for any cause, the machine operator shall direct the nozzle away from the work until it again becomes constant, or shut off the flow of materials.

2. Position of Pneumatic Nozzles: Nozzles shall be held at approximately right angles to the surface and kept at proper and equal distance from the surface, as dictated by good practice standards for the type of application, type of nozzle, and air pressure employed.

3. Shotcreting More than One Layer: Sufficient time shall be allowed for each layer of shotcrete to set up so it may take the next layer without sagging.

   a. The shotcrete shall be started at the bottom of the wall until all wrapped strand has been covered. Subsequent shotcrete layers may be applied from the top down or from the bottom up at the discretion of the Tank Contractor.

   b. As the nozzle travels around the wall, the nozzle shall be raised or lowered at a uniform rate to create an adequate overlapping of coatings and a uniform finish.

   c. The nozzle shall be spiraled up or down around the tank to either the top or the bottom of the wall or to the termination of the intermediate strand layer.

4. Application of Shotcrete: To ensure proper penetration around the strand and proper conveyance of the material through the hose, mortar slump shall be as recommended by the prestressing operator.

   a. The application of the shotcrete in the number and thickness of layers specified herein is mandatory for proper penetration of shotcrete behind the strand and to reduce shrinkage due to more uniform in-depth drying of the shotcrete.

5. Shotcrete Cover Coats Over Wrapped Strand: Each layer of wrapped prestressing steel shall be covered with shotcrete until a minimum cover of 3/8 inch over the steel has been obtained.

   a. The final overcoat, to make up for the full thickness of shotcrete over the final strand layer, shall be applied in layers of equal thickness, no greater than 3/4” thick. Full thickness of shotcrete

over final strand layer shall be a minimum of 2” for wall section below grade, and 1.5” above grade.

b. Each layer of shotcrete shall be completed for the full circumference of the tank and substantially the full height of that layer before the next layer of shotcrete may be applied.

6. Coating Thickness: All shotcrete coatings shall be built up in layers no greater than 3/4 inch in thickness until the final required thickness has been obtained. Total Cover coat thickness shall be controlled by shooting guide wires unless applied with automated equipment.

7. Protection of Adjacent Buildings and Surface: Tank Contractor shall take every possible precaution to protect adjacent buildings, concrete surfaces, vehicles, equipment, etc., from being damaged by overshooting shotcrete and by materials carried away by the wind. Overshot shotcrete and rebound materials deposited on the roof shall be removed before it adheres to the concrete surface. Tank Contractor shall pay for all damages caused by his operations under this contract.

8. Testing of shotcrete shall conform to Section 03300.

D. Hand Placed Shotcrete for Repairs Only

1. The nozzle operator shall be a certified ACI 506 nozzleman capable of applying thin coats of even and uniform thickness.

E. Weather Limitations

1. Shotcrete shall not be applied under such strong wind conditions that a considerable amount of cement and moisture will be removed by the wind from the mortar spray between the nozzle and the surface on which the shotcrete is applied.

2. Shotcrete shall not be placed in freezing weather without provisions for protection against freezing. Shotcrete placement can start without special protection when the temperature is 35 degrees Fahrenheit and rising, and must be suspended when the temperature is 40 degrees Fahrenheit and falling. The surface to which the shotcrete is applied must be free from frost. Cold weather shotcreting shall be in accordance with ACI 301 and ACI 306.

3. Hot weather shotcreting shall be in accordance with the requirements of ACI 301 and ACI 305.

4. Whenever rain or frost has damaged shotcrete which has not had a chance to set up, such shotcrete shall be removed and replaced.

F. Shotcrete Watercuring

1. Intermediate layers of shotcrete shall be kept damp by hand curing or other means no sooner than 12 hours after the shotcrete has been applied.

2. Watercuring is not required should additional shotcrete be applied on the entire wall surface within the following 12 hours.

3. Indiscriminate use of continuous watercure for intermediate layers shall be avoided.

4. Complete shotcrete surfaces, which do not receive any additional coatings, shall be watercured for a period of at least seven (7) days by encapsulating the shotcrete inside of plastic sheeting. Such plastic sheeting shall be lapped and sealed as necessary to properly cure the shotcrete. Membrane curing methods utilizing curing compounds or wax-based residuals will not be permitted.

3.11 SAFETY PRECAUTIONS

A. Safety shall be the Tank Contractor's responsibility. Required safety procedures and warnings shall be posted at the job site at all times.

B. Every precaution shall be taken to keep personnel and visitors outside the danger area of breaking strands or bars.

C. At no time shall anyone stand in the line of stressed vertical thread bars or stressed strand.

D. No work shall be performed by anyone, other than the prestressing crew, within 100 feet from the wrapping operation or the application of the vertical thread bar stressing operation.

E. Where access to the site by unauthorized persons is outside the Tank Contractor's control, while prestressing work is in progress, the Tank Contractor shall erect protective fencing to prevent breaking strands or cable from endangering such workers.

F. There shall be no welding to anchor plates after the thread bars have been assembled, neither shall prestressing steel be used as a "ground" for welding operations.

3.12 INTERIOR CLEANING

A. After construction is completed, the interior of the tank shall be completely hosed out and cleaned of all dirt and loose material in accordance with Section 02620 Hydraulic Structures Disinfection.

3.13 FINISHES

A. The floor slab shall receive a steel trowel finish. Exterior shotcrete shall receive a nozzle finish.

B. The top of the wall footing, exterior to the waterstop, shall receive a steel trowel or magnesium trowel finish

C. The interior surface of the wall shall receive a form finish.

D. The exterior of the roof shall receive a light broom finish. The interior of the roof shall receive a form finish.

E. Backfilled wall areas shall be waterproofed after tank water tightness testing with two coats of heavy bitumastic and sheets of prefabricated drainage composite placed over the water proofing in accordance with Section 02215.

3.14 WATERTIGHTNESS TEST

A. Upon completion the tank shall be tested to determine water tightness. After filling the tank the water level shall be held at the maximum operating water surface for a period of 24 hours.

B. The tank shall be filled with potable water to the maximum level. Water will be furnished by the City. The test shall consist of measuring the liquid level over the next 24 hours to determine if any change has occurred. If a change is observed and exceeds the maximum allowance, the test shall be extended to a total of five days. If at the end of five days the average daily change has not exceeded the maximum allowance, the test shall be considered satisfactory.

C. The tanks and drain lines from the ring drain shall then be examined for evidence of leaks. All leaks shall be repaired to the satisfaction of the Engineer. The tests shall be made prior to application of waterproofing coating. Exterior damp spots shall be corrected prior to cement plaster application or waterproofing. Testing shall be completed before the tank wall or footing is backfilled. Any areas that, in the opinion of the Engineer, are exposed to contamination during the repair work shall be rechlorinated to the Engineer's satisfaction.

D. The liquid volume loss for a period of 24 hours shall not exceed one-twentieth of one percent of the tank capacity, 0.0005 x tank volume and per AWWA D110. If the liquid volume loss exceeds this amount, it shall be considered excessive, and the tank shall be repaired and retested.

E. There shall be no visible running leaks or water puddles. Standing water on the footing will not be permitted. Measurable flow in this area is not permissible and must be corrected.

F. Leakage or seepage revealed by the test, including those caused by shrinkage of concrete, honeycombed areas, construction joints, or other sources shall be repaired by grouting the joint by drilling grout holes to the affected crack or honeycombed area and installing injection ports and forcing epoxy grout into the joint under pressure. Work shall be conducted and epoxy pumped by qualified operators until such cracks and voids have been completely sealed. Epoxy grouting shall comply with AWWA D110, Section 5.14.

G. The Tank Contractor shall retest tanks which have been repaired to check the suitability of repairs. For the initial test of water tightness for the new tank, water will be provided free of charge by the City. Should the tank fail the initial water tightness test, the Tank Contractor shall pay the City for all water required for subsequent tests. The cost of water for each re-test will be $1,000. Water required for the testing and retesting shall be disposed of so as not to create a nuisance.

3.15 DISINFECTING AND FILLING

A. Upon completion of water tightness testing the tank shall be drained and water containing 50 mg/l available chlorine shall be sprayed on all wall, column, and underside roof areas in accordance with Section 02620 Hydraulic Structures Disinfection. Bacteriological testing shall conform to AWWA C652.

B. Should tests fail, the disinfection process shall be repeated. Should any disinfected water require discharge to surface drains, water shall be dechlorinated and shall be in compliance with applicable regulations of the Regional Water Quality Control Board and the City. Reuse and reclamation of spent water for landscaping or construction purposes is encouraged.

3.16 ACCEPTANCE

A. The tank shall not be backfilled until after successful leak testing and all coatings are fully cured and acceptable to the Engineer.

3.17 CLEAN-UP

A. The premises shall be kept clean and orderly at all times during the work. Upon completion of construction, the Tank Contractor shall remove or otherwise dispose of all rubbish and other materials caused by the construction operation.

END OF SECTION

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SECTION 03100

CONCRETE FORMWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Formwork used for cast-in-place concrete reservoirs, and its construction. Forms shall be designed, constructed, and maintained so as to insure that after removal of forms the finished concrete will have true surfaces free of offset, waviness or bulges and will conform accurately to the indicated shapes, dimensions, lines, elevations, and positions. Provide opening in forms for the embedded work of other sections. Install embedded items furnished in Sections 05501 and 05505. Provide all form accessories and form stripping after concrete has cured.

B. Design for formwork and falsework is the Contractor's responsibility. The Contractor shall obtain the services of a civil or structural engineer currently registered in the State of California to review and stamp formwork and falsework design.

C. Pre-inspection of the falsework or vertical shoring prior to placement of concrete is the Contractor's responsibility. An engineer who is currently registered as a civil or structural engineer in the State of California shall supervise the pre-inspection of the falsework or vertical shoring system for conformity with the working drawings.

1.02 REFERENCED SECTIONS

A. Requirements of this section include, but are not limited to, requirements specified in the following sections:

1. Section 01330 - Submittals
2. Section 03300 – Cast-In-Place Concrete
3. Section 05501 – Anchor Bolts
4. Section 05505 – Miscellaneous Metal Work

1.03 REFERENCED PUBLICATIONS

A. General

1. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed standards, the requirements of this section shall prevail.

B. AMERICAN CONCRETE INSTITUTE (ACI) STANDARDS

1. ACI 301 – Specifications for Structural Concrete for Buildings
2. ACI 347R – Formwork for Concrete
3. ACI 350R – Environmental Engineering Concrete Structures

C. U.S. DEPARTMENT OF COMMERCE, NATIONAL BUREAU OF STANDARDS PUBLICATIONS, PRODUCT STANDARDS:

1. PS 1 – Construction and Industrial Plywood

1.04 SUBMITTALS

A. Comply with Section 01330 and submit for information.

B. Formwork: Before starting concrete work, submit drawings of all formwork showing form plywood patterns, formwork, ties, vertical limits of concrete placements, horizontal lifts, and construction joints. Shop drawings shall be prepared and stamped by a civil or structural engineer currently registered in the State of California.

C. Shoring: If shoring the structure is required, submit drawings and structural calculations showing members, connections, and anchorage of the proposed shoring system. Shop drawings shall be prepared and stamped by a civil or structural engineer currently registered in the State of California.

D. Manufacturer's Data

1. Form System

2. Form Material

3. Form Accessories

E. Coordination (Lift) Drawings:

1. The Contractor shall submit for review and comment coordination (lift) drawings for all concrete placements. These drawings shall show as a minimum the following information:

a. Construction joint location.

b. Construction joint type.

c. Waterstop.

d. All embedded material/items (architectural, mechanical, electrical, etc.).

e. All openings and penetrations.

2. Coordination drawings shall show concrete type, concrete quantity, finish, and curing requirements. If more than one placement is shown, the placing sequence shall be indicated. Each concrete placement shall have a separate schedule activity.

3. The CPM schedule activity for each concrete placement shall be shown on the coordination drawings. The coordination drawings shall be certified for completeness and accuracy by the Contractor prior to submittal

PART 2 - PRODUCTS

2.01 FORM SYSTEM

1. A custom engineered form system or a manufacturer's standard system may be used. Manufactured systems shall be by the Burke Company, Symons Corporation, or approved equal.

2.02 FORM MATERIALS

A. Plywood shall be PS 1, B-B Plyform Class 1, EXT-APA, edge-sealed, 5/8 inch thick when studs are spaced 12 inches on center and 3/4 inch thick when studs are spaced 16 inches on center.

B. Formboard shall be phenolic resin covered form board and shall be 3/4-inch thick Douglas fir APA inspected, 5-ply panel, cross laminated with waterproof phenolic resins one side and sanded "B" Grade on the back. Resin coated plywood shall be Burke Concrete Accessories "Neotex Form Panels", or approved equal.

C. Wood strips for forming reveals, chamfers and quirks shall be closed grain hardwood, free of knots, or PVC strip with nailing legs.

D. Framing lumber shall be Douglas fir "Standard" grade, sized to uniform width and depth.

E. Sheathing shall be Douglas fir "Construction" grade boards and sheathing, 10-inch maximum width.

F. Aluminum and steel panels and components shall be part of a manufacturer's standard or engineered form system.

2.03 FORM TIES AND ACCESSORIES

A. For liquid retaining structures ties shall have a minimum 1-1/2-inch break-back and plastic cones 1-1/4-inch diameter with sharp taper, 1-1/2 inches long. The tie system shall be leakproof. Provide each tie with a neoprene waterseal washer at the midpoint. Furnish Dayton-Superior A series with A-8 washer, Symons S series with water seal, or approved equal.

B. Other formed concrete ties shall be adjustable type, arranged to leave no metal within 1 inch of surface. They shall have no lugs, cones, or other devices that will leave holes larger than 1 inch diameter in exposed concrete surfaces. Spreaders shall be either type designed for use with approved clamps of separate metal spreaders. Do not use wood spreaders or wire ties. Furnish Burke Pentaties series, Symons S series, or approved equal.

C. Form coating shall be Burke QC release agent or approved equal.

D. Plywood form joint tape shall be Burke Vinyl foam tape, or approved equal.

E. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Plugs shall be A-58 SURE PLUG as manufactured by Dayton Superior, Santa Fe Springs, CA.

F. Ties shall positively secure the wall to the required dimension and hold the wall to that dimension prior to and during concrete placement.

G. Through-ties which are to be entirely removed from the structure shall be tapered over the portion which passes through concrete. Where used on reservoir, wide end shall be at inside of structure.

H. Embeco or other fast-setting cements/additives shall not be used for damp-packing such cavities.

2.04 WALL FORMS

A. Full Height Pours

1. The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.

2. A plastic shotcrete reglet shall be incorporated into the top of the tank corewall as shown on the Plans.

B. Form Size

1. Burke, Economy, Symons, Aluma, and regular plywood forms may be used for forming of circular walls, as long as the`re are no straight sections longer than 36 inches at any place around the outside circumference of such walls.

2. The height of such wall panels shall not exceed 8 feet unless built-in pouring openings are incorporated in such wall panels

PART 3 - EXECUTION

3.01 GENERAL

A. Design construction, erection, use and removal is the Contractor's responsibility and shall conform to ACI 301, 347R and 350R and as specified herein.

B. Formwork shall be installed so that it will safely support all vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Vertical or lateral loads must be carried to the ground by the formwork and shoring system or by the in-place construction that has adequate capacity for that purpose. Formwork and falsework vertical and lateral loads shall also include live loads, wind loads, and construction loads together with appropriate safety factors and load multipliers to conform with ACI 347R. All formwork shall be mortar tight. Tie systems shall provide for positive pressure at all joints to preclude grout leakage. The Contractor shall design and construct formwork to impart to the concrete only the geometry shown on Plans, unless otherwise approved by the Engineer. Formwork shall be designed to allow removal without damage to the concrete.

C. Provide openings for mechanical and electrical work and work of other sections. Place items specified in Sections 05501 and 05505 which are to be embedded in concrete and support on framework. Seal forms around openings to prevent concrete seepage.

D. Exposed-to-view architectural concrete deflection of facing materials between studs, as well as deflection of studs and walers, shall be limited to a deflection of 1/32 of an inch or 0.0025 times the span length, whichever is the larger, at the midpoint between supports.

E. Exposed-to-view concrete deflection of facing materials between studs, as well as deflection of studs and walers, shall be limited to 3/64 of an inch or 0.004 times the span length, whichever is the larger, at the midpoint between supports.

F. Unless otherwise specified, exposed edges of concrete on the outside of structures and all those in the inside of structures shall be chamfered or beveled at an angle of 45 degrees by using a PVC chamfer strip with nailing leg, such bevel being 3/4 inch on a side. If so directed by the Engineer, however, the Contractor shall provide square edges for any portion of the work. Tape and seal all reveal strips to prevent leakage and leave a perfectly smooth finish.

3.02 INSPECTION

A. At least 2 days prior to a scheduled concrete placement the Contractor shall notify the Engineer in writing that forms, embeds, blockouts, penetrations, reinforcing steel, waterstop, etc. are installed in conformance with the approved coordination drawings; the forms are properly constructed, aligned and braced; and that the forms have been cleaned of all debris and deleterious matter.

B. After notification and prior to concrete placement, the Contractor will review and certify that the concrete placement is ready for concrete.

3.03 CONSTRUCTION TOLERANCES

A. Construct forms to provide concrete conforming to dimensions shown and to tolerance limits listed in ACI 301.

B. Every precaution shall be taken to see that all forms are in the proper alignment, plumb, placed to correct radius and that all form supports are secure and tight.

C. Form sills shall be used to contain or hold down neoprene pads and facilitate proper alignment of forms. The maximum permissible variation in the horizontal and vertical location of the waterstops, neoprene pads and seismic cables (if required) is plus or minus 1/4 of an inch.

D. The maximum permissible variation in tank radius, as measured from the center of the tank to the inside wall surface at the bottom, is plus or minus 3/8 of an inch.

E. The out-of-round tolerance is: 3/4" in 50', 3/8" in 10' and 3/16" in 24" from the true curvature specified at any point on the wall.

F. The maximum permissible variation in the vertical alignment, from the bottom to the top of the wall, is plus or minus 3/8 of an inch.

G. The allowable tolerance in the average wall thickness for poured walls shall not vary more than 1/8 inch either way. All transitions from plus to minus shall be gradual, even and smooth, and without abrupt changes in the surfaces.

H. Adequate time and cooperation shall be provided to the Inspector to verify the compliance of these requirements prior to closing up the forms or pouring concrete.

3.04 INSTALLATION

A. Installation shall conform to ACI 301, 347R and 350R. Design forms for easy removal.

B. Forms shall not be used if there is any evidence of surface wear or tear which would impair the quality of the exposed-to-view concrete.

C. Forms shall be thoroughly cleaned and relubricated before re-use.

D. Formwork for exposed to view concrete shall be observed continuously while concrete is being placed to see that there are no changes of elevation, plumbness, or camber.

E. If, during construction, any weakness develops and the falsework shows any undue settlement or distortion, the work shall be stopped, the affected construction removed, if permanently damaged, and the falsework strengthened.

3.05 CONSTRUCTION AND SURFACE FINISH

A. Forms shall be substantial, true to line and level, sufficiently tight to prevent leakage and shall conform exactly to indicated dimensions. Provide cleanout holes at bottom of forms. Remove debris before concrete is placed. Construct forms for exposed surfaces so that joints in forms are either horizontal or vertical and are located to the pattern indicated. External corners on all architectural concrete shall be formed with camber strips in corners of forms to form bevel at external angles.

B. All form joints in forms for exposed to view concrete shall be sealed with specified form tape to prevent leakage. Camber soffits to accommodate anticipated deflections caused by wet concrete and construction loads. Provide positive means of adjustment for shores and struts. Take up settlement as concrete is placed.

C. Wall Form - Pour Openings

1. Pouring of walls may be done only through pouring openings on one of the wall sides, and may not be pumped or poured from the top through the use of "elephant trunks" or tremies.

2. Contractor shall either erect the complete form on one side of the wall and then erect the form panels on the other side of the wall while the concrete pour is in progress or remove form panels from either the inside or outside form assembly before concrete pouring starts.

3. The horizontal centerline distance between such openings shall not exceed 96 inches nor shall the distance between the nearest opening and the bulkhead for the vertical joint exceed 36 inches.

4. The vertical centerline distance between horizontal rows of openings shall not exceed 96 inches.

5. The minimum pouring opening size shall be 18" x 18".

6. The bottom of the lower openings shall be no more than 48 inches from the top of the wall-footing.

7. Under no circumstances shall forming be such that the drop of concrete in the forms will exceed 8 feet in any one place.

3.06 REMOVAL AND REUSE

A. Removal of forms shall conform to ACI 347R, 350R and as specified herein. Remove forms, shoring and bracing carefully to avoid damage to fresh concrete, but not before concrete is capable of self-support and support of construction loads.

B. Do not pry against face of concrete. Use wooden wedges only.

C. In order that reused forms will not contain patches resulting from alterations, forms for concrete exposed to view shall be reused only on identical sections.

D. When forms are removed during specified curing period, cure the concrete as specified in Section 03300.

E. Regardless of strengths attained by concrete, leave forms in place for following periods when supporting:

1. Vertical surfaces: 3 days minimum

2. Slabs: 7 days minimum

3. Beams and Girders: 15 days minimum, but do not remove vertical support until concrete has reached its 28-day strength.

4. Reservoir Wall and Columns: 24 hours of accumulated time with the ambient air temperature above 50°after completion of pour.

F. In hot, dry weather wood forms remaining in place which do not provide adequate curing shall be removed or loosened so that the concrete surfaces can be kept moist or coated with a curing membrane. In cold weather, removal of formwork shall be deferred or formwork shall be replaced with insulation blankets to avoid thermal shock and consequent crazing of the concrete surface.

G. Before reuse of plywood forms, thoroughly clean, sand and recoat with an effective bond breaking form coating in conformance with ACI 347R. Do not reuse plywood that has torn grain, patches, worn edges, damaged phenolic resin covered surfaces, or other defects which would impair texture of finished surface. Other wood forms shall be prepared for reuse by thorough cleaning and recoat with form coating. Repair damaged forms and replace loose or damaged boards.

3.07 FORM TIES

A. Form tie assemblies shall permit tightening of the forms and be of such type as to leave no metal or other material within 1-1/2 inches of the surface. The assembly shall provide cone-shaped depressions in the forms at the surface at least 1-1/4 inches in diameter and 1-1/2 inches deep to allow filling and patching per Section 03300. Ties shall be tight fitting, or tie holes in forms shall be sealed to prevent leakage where ties penetrate the form.

B. When a portion of single rod ties are to remain in a liquid retaining structure, the portion that is to remain shall be provided with a tightly fitted washer at midpoint. Through ties that are to be entirely removed from the structure shall be tapered over the portion which passes through the concrete.

3.08 SHORING

A. Plans for shoring and reshoring operations shall conform to ACI 347R. Live loading of new construction while reshoring is under way is not permitted. Do not over stress new construction by over tightening reshores. Leave reshores in place until concrete has reached its specified 28-day strength. Reshore floors that support shores under wet concrete, or leave original shores in place. Reshores shall have at least half the capacity of the shores above and be distributed in approximately the same pattern. Leave these reshores in place until freshly placed concrete has reached 75 percent of its specified 28-day strength.

3.09 MATERIAL APPLICATION

Concrete exposed to view in completed structures:

A. For smooth architectural concrete use specified phenolic resin covered form board.

B. For all other exposed to view concrete; Use specified "B-B" plyform plywood or the phenolic resin covered form board or aluminum and steel when part of a form system.

C. For forms for concrete surfaces not visible in completed structure use plywood, lumber aluminum or steel. Footings may be poured directly against earth banks where soil conditions are such that vertical banks will remain stable during placing operations. Earth forms at walls are not permitted.

END OF SECTION

SECTION 03200

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Reinforcing steel for use in reinforced concrete reservoirs.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01330 – Submittals
2. Section 03300 – Cast-In-Place Concrete

1.03 QUALITY ASSURANCE

A. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The largest edition of referenced publications in effect at the time of bid shall govern. In case of conflict between the requirements of this section and the listed standards, the requirements of this section shall prevail.

1. ACI 315 – Details and Detailing of Concrete Reinforcement
2. ASTM A82 – Steel Wire, Plain, for Concrete Reinforcement
3. ASTM A185 – Steel Welded Wire, Fabric, Plain for Concrete Reinforcement
4. ASTM A615–- Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
5. ASTM A706 – Low-Alloy Steel Deformed Bars for Concrete Reinforcement
6. ASTM A775/A775M – Epoxy-Coated Reinforcing Steel Bars
7. AWS D1.4 – Structural Welding Code-Reinforcing Steel
8. CRSI-PRB – Placing Reinforcing Bars
9. CRSI-MSP 1 – Manual of Standard Practice
10. FEDSPEC QQ-W-461H – Wire, Steel, Carbon (Round, Bare, and Coated)

1.04 SUBMITTAL

A. Comply with Section 01330 and submit the following:

1. Bar placement drawings.
2. Bar lists and bending details.
3. Certified mill test reports.
4. Welder qualification certificate in accordance with AWS D1.4.
5. Bar support catalog sheets.

PART 2 - PRODUCTS

2.01 BAR REINFORCEMENT

A. Reinforcing bars shall be deformed billet steel in conformance with ASTM A615, including supplementary requirements.

B. Bars shall be Grade 60, except ties or field-bent bars where specified shall be Grade 40.

C. Bars to be welded shall be Grade 40 or shall be deformed billet steel conforming to ASTM A706. ASTM A616 or ASTM A617 steel shall not be used.

D. Bars provided as dowels for future construction and bars where specified shall be epoxy-coated in conformance with ASTM A775.

E. Bars shall be free of rust, oils, or other substances which might impair bond with concrete.

F. Bars shall be stored under cover and not in contact with ground.

2.02 WIRE FABRIC

A. Wire fabric shall be welded steel mesh conforming to ASTM A185.

2.03 WIRE AND PLAIN BARS

A. Wire used as reinforcement and bars used as spiral reinforcement in structures shall be cold drawn steel conforming to ASTM A82.

2.04 TIE WIRE

A. The wire shall be minimum 16 gage annealed steel conforming to FEDSPEC QQ-W-461H.

2.05 BAR SUPPORTS

A. Bar supports coming into contact with forms shall be CRSI Class 1 plastic protected or Class 2 stainless steel protected and shall be located in accordance with CRSI MSP-1 and placed in accordance with CRSI PRB.

B. Concrete block supports shall be provided for footing and slabs on grade and shall have compressive strength at least as great as required in Section 03300 for concrete element being placed.

C. Stainless steel or plastic protected plain steel supports shall be provided for other work.

PART 3 - EXECUTION

3.01 FABRICATION

A. Bends and lap splice lengths in reinforcing bars shall conform to ACI 315. Reinforcing steel shall not be bent or straightened in a manner which will injure the material.

B. Bars with kinks or with bends not shown shall not be used. Heating or welding bars shall be performed in accordance with AWS D1.4 and shall only be permitted where specified or approved by the Engineer.

C. Bars shall not be welded at the bend. Reinforcing bars shall be fabricated according to the Drawings.

3.02 PLACEMENT

A. Reinforcing steel shall be placed in accordance with CRSI PRB and CRSI MSP-1.

B. Reinforcing steel shall be positioned accurately and secured against displacement by using annealed iron wire at intersections and shall be supported by concrete or metal chairs, spacers or metal hangers. Tack welding of cross bars is not acceptable. Bars shown on the drawings shall not be repositioned (buried) to act as support bars. Additional bars shall be provided as required for supports. Steel rods and pegs may be used to support reinforcing steel on rock foundations. Reinforcing steel shall be placed in such a manner as to not damage waterproofing membrane or plastic lining which has been previously applied or constructed. Reinforcing steel shall be shop-bent or slightly relocated where necessary to clear waterstop. Reinforcing steel shall not be placed on fresh concrete or forced into fresh concrete.

C. Supports for embedded items shall not be welded to the reinforcement. Additional reinforcement may be provided for this purpose.

3.03 SPLICING

A. Reinforcing steel shall be spliced as shown. Additional splices may be provided where approved by the Engineer.

B. In slabs, beams, girders and walls, reinforcing steel shall not be spliced in areas of maximum stress. Splices of adjacent bars shall be staggered at least one splice length, unless otherwise specified. Splices in welded wire fabric shall be at least 1 1/2 meshes wide.

3.04 CLEANING

A. Reinforcing steel shall be cleaned so that no mill rust scale, dried concrete, or other coatings that may reduce bond are present immediately before concrete placement.

B. Reinforcement reduced in section is not acceptable.

C. When concrete placement is delayed, reinforcement shall be cleaned by sandblasting if directed by the Engineer.

3.05 REPAIR OF EPOXY COATING

A. Epoxy coating damage need not be repaired in cases where the damaged area is 0.1 square inch or smaller. All damaged areas larger than 0.1 square inch shall be repaired in conformance with ASTM A775.

END OF SECTION

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SECTION 03301

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Requirements for cast-in-place concrete work other than concrete for the prestressed concrete reservoir.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section.

1. 01330 – Submittals

1.03 SUBMITTALS

A. Comply with Section 01330.

B. Shop Drawings

1. Reinforcing steel in accordance with CRSI 1990 Manual of Standard Practice and ACI SP.
2. Curing compound data.
3. Complete data on the concrete mix, including aggregate gradations and admixtures, in accordance with ASTM C94.
4. Data compiled by a certified Testing Laboratory from a minimum of 30 previous compression tests and 10 previous drying shrinkage tests, for each mix design submitted.

C. Quality Control Submittals

1. Manufacturer's application instructions for curing compound.
2. Ready-mix delivery tickets for each truck in accordance with ASTM C94.
3. Field sampling test data.

1.04 QUALITY ASSURANCE

A. Codes and Standards

1. Comply with all Federal, State and Local Codes and Safety Regulations. In addition, comply with the provisions of the following codes, specifications, and standards, except where more stringent requirements are shown or specified:

a. California Building Code, CBC.

b. Formwork: Follow the recommendations of ACI 347, unless otherwise specified.

c. Concrete and Reinforcement: Unless otherwise specified, meet the requirements of ACI 301 and 318/318R.

d. Hot Weather Concreting: Conform to ACI 305R.

B. Field Sampling

1. Field sampling and testing shall be performed by an independent testing laboratory under contract to the Contractor. Laboratory shall be accepted by Engineer prior to construction.

2. Field sampling and testing shall include concrete strength, slump, and air content.

3. Concrete strengths shall be verified by testing standard cylinders of concrete samples taken at the job site.

4. A final report, prepared by the Contractor's testing laboratory, shall be provided at the completion of all concreting testing.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Do not use curing compound where solvents in the curing compounds are prohibited by state or federal air quality laws. Use only water curing methods.

PART 2 - PRODUCTS

2.01 CONCRETE

A. Ready-mixed meeting ASTM C94, Option A.

B. Portland Cement: ASTM C150, Type II.

C. Aggregates: Furnish from one source.

1. Natural Aggregates

a. Free from deleterious coatings and substances in accordance with ASTM C33, except as modified herein.

b. Free of materials and aggregate types causing pop outs, discoloration, staining, or other defects on surface of concrete.

2. Non-Potentially Reactive: In accordance with ASTM C33, Appendix XI, paragraph X1.1.

3. Aggregate Soundness: Test for fine and coarse aggregates in accordance with ASTM C33 and ASTM C88 using sodium sulfate solution.

4. Fine Aggregates

a. Clean, sharp, natural sand.

b. ASTM C33.

c. Materials Passing 200 Sieve: 4 percent maximum.

d. Limit deleterious substances in accordance with ASTM C33, Table 1 with material finer than 200 sieve limited to three percent, coal and lignite limited to 0.5 percent.

5. Coarse Aggregate

a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no

more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).

b. Materials Passing 200 Sieve: 0.5 percent maximum.

D. Admixtures

1. Air-Entraining: ASTM C260.
2. Water-Reducing: ASTM C494, Type A or D.
3. Superplasticizers: ASTM C494, Type F or G.
4. Fly Ash: ASTM C618, Class C or F.
5. Color Pigments: Inert mineral or metal oxide pigments, either natural or synthetic; resistant to lime and other alkalies.

E. Mix Design

1. Minimum Allowable 28-day Compressive Field Strength when cured and tested in accordance with ASTM C31 and C39.
   a. Footings, vaults, building slab: 4,000 psi
   b. Site Concrete: 3,000 psi (fence concrete and other minor site concrete)
2. Coarse Aggregate Size: 1½ inches and smaller.
3. Slump Range: three to five inches.
4. Air Entrainment: Between one and three percent by volume.
5. Water Reducers: Use in concrete without plasticizers.

F. Proportions

1. Design mix to meet aesthetic and structural concrete requirements.
2. Water-cement ratio (or water-cement plus fly ash ratio) shall control amount of total water added to concrete as follows:

Coarse Aggregate Size	W/C Ratio
1½ inch	0.45
1 inch	0.40

3. Minimum Cement Content (or Combined Cement Plus Fly Ash Content When Fly Ash is Used):
   a. 540 pounds per cubic yard for concrete with 1½-inch maximum size aggregate.
   b. 564 pounds per cubic yard for one-inch maximum size aggregate.
4. Increase cement content or combined cement plus fly ash content, as required to meet strength requirements and water-cement ratio.

G. Mixing: Minimum 70 and maximum 270 revolutions of mixing drum. Non-agitating equipment is not allowed.

2.02 REINFORCING STEEL

A. Deformed Bars: ASTM A615, Grade 60. Reinforcing steel to be welded shall be ASTM A706, Grade 60.

B. Welded Wire Fabric: ASTM A497.

2.03 ANCILLARY MATERIALS

A. Cast-in-Place Anchor Bolts, Expansion Anchors, Headed Studs, Epoxy Adhesive Anchors and Dowels: see Section 05501.

B. Expansion Joint Filler: ASTM D994, ½ inch thick, or as shown.

C. Waterstops

1. Manufactured from virgin polyvinylchloride (PVC) conforming to the Corps of Engineers Specification No. CRD-C572.

2. 6-inch, heavy-duty Flex-Bulb or flat strip as manufactured by the Greenstreak Company, Water Seals, Inc., or equal; and as shown on the structural drawing details.

D. Bonding Compounds

1. Epoxy resin bonding compounds: Used for wet areas

2. Manufacturers

a. Master Builder, Concresive Nos. 1001, 1001-LPL or 1180 as applicable;

b. Sika Chemical Corporation, Sikadur 35, Hi-Mod LV, Sikadur 32, Hi-Mod, or Sikadur 31, Hi-Mod Gel as applicable;

c. Burke Company 881 LPL Epoxy;

d. or equal.

3. Non-epoxy bonding compounds: Used for dry areas

4. Manufacturers

a. Burke Company, Acrylic Bondcrete;

b. Imperial Chemical Industrial, Inc., Thoro System Products, Acryl 60; Thorobond; or equal.

5. Apply bonding compounds in accordance with the manufacturer's instructions.

E. Curing Compound

1. Material: Solvent based containing chlorinated rubber solids in accordance with ASTM C309, with additional requirement that the moisture loss not exceed 0.030 gram per centimeter squared per 72 hours.

2. Manufacturers and Products:

3. Chemrex Inc., Shakopee, MN; Masterkure CR.

4. Euclid Chemical Co.; Euco Super Floor Coat.

F. Surface Hardener

1. Premixed, noncolored, nonmetallic Master Builders, Mastercron; Sonneborn, Harcol; A. C. Horn Inc., Durafax; Burke Company Non-Metallic Floor Hardner; or equal.

2. Apply in accordance with manufacturer's instructions.

G. Concrete for Electrical Conduits

1. Concrete encasement for electrical conduit shall contain 3 pounds of red oxide per sack of cement.

PART 3 - EXECUTION

3.01 FORMWORK

A. Form Materials

1. Use hard plastic finished plywood for exposed areas, and new ship lap or plywood for unexposed areas.

2. Earth cuts may be used for forming footings.

B. Form Ties

1. Fixed conical or spherical type inserts that remain in contact with forming material and allow for dry packing of form tie holes.

2. Ties shall withstand pressures and limit deflection of forms to acceptable limits.

3. Wire ties are not acceptable.

C. Construction

1. In accordance with ACI 347.

2. Make joints tight to prevent escape of mortar and to avoid formation of fins.

3. Brace as required to prevent distortion during concrete placement.

4. On exposed surfaces locate form ties in uniform pattern or as shown.

5. Construct so ties remain embedded in the wall with no metal within 1-inch of concrete surface when forms, inserts, and tie ends are removed.

D. Form Removal

1. Remove after concrete has attained 28-day strength, or approval is obtained in writing from Engineer.

2. Remove forms with care to prevent scarring and damaging the surface.

3.02 PLACING REINFORCING STEEL

A. Unless otherwise specified, place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars.

B. Splices and Laps

1. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.

2. Horizontal wall bars are considered top bars.

3. All bar lap splices shall be Class B in accordance with ACI 318-95.

4. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Prior to placing concrete, remove water from excavation and debris and foreign material from forms. Check reinforcing steel for proper placement and correct discrepancies.

C. Before depositing new concrete on old concrete, clean surface using sandblast or bush hammer or other mechanical means to obtain a ¼ inch rough profile, and pour a cement-sand grout to minimum depth of ½ inch over the surface. Proportion 1 part cement to 2.5 parts sand by weight.

D. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over two feet deep. Place within 1½ hours after adding cement to mix.

E. Eight feet maximum vertical drop to final placement, when not guided with chutes or other devices to prevent segregation due to impact with reinforcing.

F. Hot Weather

G. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 305R.

1. Maintain concrete temperature below 80 degrees F at time of placement, or furnish test data or provide other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking due to heat of hydration. Ingredients may be cooled before mixing to maintain fresh concrete temperatures at 80 degrees F or less.

2. Make provisions for windbreaks, shading, fog spraying, sprinkling, ice, or wet cover, or other means to provide concrete with temperature specified.

3. Prevent differential temperature between reinforcing steel and concrete.

3.04 COMPACTION

A. Vibrate concrete as follows:

1. Apply approved vibrator at points spaced not farther apart than vibrator's effective radius.

2. Apply close enough to forms to vibrate surface effectively but not damage form surfaces.

3. Vibrate until concrete becomes uniformly plastic.

4. Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

3.05 CONSTRUCTION JOINTS

A. Locate as shown or as approved.

B. Maximum Spacing Between Construction Joints: 40 feet.

3.06 FINISHING

A. Floor Slabs and Tops of Walls

1. Screed surfaces to true level planes.
2. After initial water has been absorbed, float with wood float and trowel with steel trowel to smooth finish free from trowel marks.
3. Do not absorb wet spots with neat cement.

B. Unexposed Slab Surfaces:

1. Screed to true surface, bull float with wood float, and wood trowel to seal surface.

C. Smooth Wall Finish

1. Patch tie holes.
2. Grind off projections, fins, and rough spots.
3. Patch defective areas and repair rough spots resulting from form release agent failure or other reasons to provide smooth uniform appearance.

D. Tolerances:

1. Floors shall not vary from level or true plane more than ¼ inch in 10 feet when measured with a straightedge.

E. Exterior Slabs and Sidewalks

1. Bull float with wood float, wood trowel, and lightly trowel with steel trowel.
2. Finish with broom to obtain nonskid surface.
3. Finish exposed edges with steel edging tool.
4. Mark walks transversely at 5-foot intervals with jointing tool.

3.07 FINISHING AND PATCHING FORMED SURFACES

A. Cut out honeycombed and defective areas.

B. Cut edges perpendicular to surface at least one-inch deep. Do not feather edges. Soak area with water for 24 hours.

C. Finish surfaces to match adjacent concrete.

D. Keep patches damp for minimum 7 days or spray with curing compound to minimize shrinking.

E. Fill form tie holes with Nonshrink Grout.

3.08 PROTECTION AND CURING

A. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.

B. Keep concrete slabs continuously wet for a seven-day period. Intermittent wetting is not acceptable.

C. Use curing compound only where approved by Engineer. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is completed.

D. Remove and replace concrete damaged by freezing.

3.09 FIELD SAMPLING AND TESTS

A. Field sampling and testing shall be performed by the Contractor at an accepted testing laboratory. Samples of aggregates and concrete shall be taken at random locations and at such times to represent the quality of the materials and work throughout the project. The laboratory shall provide the necessary labor, materials and facilities for sampling the aggregate and for casting, handling and storing the concrete samples at the site of work.

3.10 CONCRETE TESTING

A. The strengths specified for the design mix shall be verified by Contractor by testing standard cylinders of concrete samples taken at the job site.

B. Standard cylinders shall represent the concrete placed in the forms. One set of four standard cylinders shall be cast of each class of concrete for each 100 cubic yards or less or for each 4,000 square feet of surface area poured per day. A fifth cylinder shall be cast for every three sets of four cylinders. Casting, handling and curing of cylinders shall be in accordance with ASTM C31.

C. Testing of specimens for compressive strength shall be in accordance with ASTM C39. Tests shall be made at 7 and 28 days from time of casting. Two test cylinders from each group of four shall be tested at the end of 7 days and two shall be tested at the end of 28 days. The fifth cylinder shall be tested at the end of 90 days only. A strength test shall consist of the average strength of two cylinders cast from material taken from a single load of concrete.

D. Certified reports of the test results shall be provided directly to the Engineer. Test reports shall include sufficient information to identify the mix used, the stationing or location of the concrete placement, and the quantity placed. Slump, air content, temperature of concrete, and ambient temperature shall be noted. The 28-day strength test results shall be evaluated in accordance with ACI 214. Quality control charts showing field test results shall be included with the test results for each class of concrete in each major structure.

E. If the 28-day test results fall below the specified compressive strength for the class of concrete required for any portion of the work, adjustment in the proportions, water content, or both, shall be made as necessary at the Contractor's expense. Changes and adjustments shall be reported in writing to the Engineer.

F. If compressive test results indicate concrete in place may not meet structural requirements, tests shall be made to determine if the structure or portion thereof is structurally sound. Tests may include, but not be limited to, cores in accordance with ASTM C42 and any other analyses or load tests acceptable to the Engineer. Costs of such tests shall be borne by the Contractor.

G. The slump shall be as specified when measured in accordance with ASTM C143. Samples for slump determination shall be taken from the concrete during placing. Tests shall be made at the beginning of concrete placement operation and at subsequent intervals to insure that the specification requirements are met. Slump tests shall also be performed whenever standard cylinders are cast.

H. Temperature tests shall be made at frequent intervals during hot or cold weather conditions until satisfactory temperature control is established. Whenever standard cylinders are cast, temperature tests shall be performed.

I. Air content shall be as specified when measured in accordance with ASTM C231. Air content shall be measured whenever standard cylinders are cast.

3.11 FINAL LABORATORY REPORT

A. A final report, prepared by the Contractor's testing laboratory, shall be provided at the completion of all concreting. This report shall summarize the findings concerning concrete used in the project and provide totals of concrete used by class and structure. Final quality control charts for compressive strength tests for classes of concrete specified in each major structure shall be included.

END OF SECTION

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SECTION 03320

PRECAST CONCRETE STRUCTURES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. All work necessary to furnish and install precast concrete vaults and subgrade utility structures.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01330 – Submittals
2. Section 05502 – Reservoir Metal Work

1.03 SUBMITTALS

A. Comply with Section 01330 and submit the following.

1. Submit manufacturer's product data and design calculations on precast items, inserts, hatches, and all appurtenances.
2. Shop drawings showing reinforcing and materials of construction by ASTM reference and grade.

1.04 QUALITY ASSURANCE

A. Precast concrete producer shall demonstrate adherence to the standards set forth in the National Precast Concrete Association Quality Control Manual.

B. NPCA Certification - The precast concrete producer shall be certified by the National Precast Concrete Association's Plant Certification Program prior to and during production of the products for this project.

C. Qualifications, Testing and Inspection

1. The Precast concrete producer shall have been in the business of producing precast concrete products similar to those specified for a minimum of 5 years.
2. The Precast concrete producer shall show that the following tests are performed in accordance with the ASTM standards indicated. Tests shall be performed for each 150 cu. yd. of concrete placed, but not less frequently than once per week.

a. Slump: C143
b. Compressive Strength: C31, C192, C39
c. Air Content (when air-entrained concrete is being used): C231 or C173
d. Unit Weight: C138

D. The City may place an inspector in the plant when the products covered by this specification are being manufactured.

1.05 DELIVERY, STORAGE AND HANDLING

A. Handling: Products shall be stored, handled shipped and unloaded in a manner to minimize damage. Lifting holes or inserts shall be consistent with industry standards. Lifting shall be accomplished with methods or devices intended for this purpose.

B. Acceptance at Site: The City's representative will make inspection and acceptance of the precast concrete products upon arrival at the jobsite.

PART 2 - PRODUCTS

2.01 MANUFACTURED PRECAST UNITS

A. Precast Concrete: Provide all units shown on the Plans and as needed for a complete and proper installation.

B. Design Criteria - Design units in accordance with following criteria:

1. ACI 304 and 318.
2. ASTM C890
3. ASTM C913
4. ASTM C478

C. General Design Requirements

1. Consider dead load, live load, impact load, and any other loads upon the structure.
2. Live loads shall be for HS20-44 per AASHTO standard specifications. The live load shall be that which produces the maximum shears and bending moments in the structure.
3. Design units taking into account reduced cross section at openings and penetrations.
4. Minimum wall thickness shall be according to ASTM C478.
5. All calculations shall be prepared and signed by a civil or structural engineer currently registered in the State of California.

D. Specific Design Requirements

1. Concrete lid shall be cast separate from vault walls. Lid/wall joint shall be sealed with a Kalktite 340, Tufflex, Plastico, or equal black mastic joint compound.
2. Penetration and openings for piping shall be cast-in-place sleeves one pipe diameter larger that the pipe shown. The annual space between the sleeve and pipe shall be sealed with a gasketed compression band with rubber skirt as manufactured by LinkSeal or equal. Should the manufacturer of the gasketed compression band with rubber skirt recommend a different size cast-in-place sleeve, the manufacturer's recommendations shall govern.

E. Finishes

1. Formed non-architectural surfaces: Surfaces cast against approved forms using industry practice in cleaning forms, designing concrete mixes, placing and curing concrete.

2. Unformed surfaces: Surfaces finished with a vibrating screed, or by hand with a float. Normal color variations, minor indentations, minor chips and spalls will be tolerated but no major imperfections, honeycombs, or other defects shall be permitted.

3. Special finishes: Troweled, broom or other finishes shall be according to the requirements of project documents and performed per industry standards or supplier specifications.

F. Patching and Repairs

1. No repair is required to formed surfaces that are relatively free of air voids and honeycombed areas, unless the surfaces are required by the design to be finished.

2. Repairing Minor Defects: Defects that will not impair the functional use or expected life of a manufactured precast concrete product may be repaired by any method that does not impair the product.

3. Repairing Honeycombed Areas - When honeycombed areas are to be repaired, all loose material shall be removed and the areas cut back into essentially horizontal or vertical planes to a depth at which coarse aggregate particles break under chipping rather than being dislodged. Proprietary repair materials shall be used in accordance with the manufacturer's instructions.

4. Repairing Major Defects: Defects in precast concrete products which impair the functional use or the expected life of products shall be rejected.

2.02 MATERIALS

A. Compressive Strength: 4000 psi minimum 28 day compressive strength.

B. Portland Cement: ASTM C-150

C. Fly Ash: ASTM C-618

D. Aggregate: ASTM C-33

E. Reinforcing Steel: ASTM A-615 or A-706 Grade 60 for deformed bars, ASTM A185 for wire fabric

F. Air Entraining: ASTM C-260, 4%-6% entrained air by volume

G. Water Reducers: ASTM C-494

H. Accelerators: ASTM C-494

I. Super Plasticers: ASTM C-1017

2.03 VAULT ACCESS DOORS

A. Per Section 05502 of these Specifications unless otherwise indicated.

B. Access doors shall mount flush.

C. All vaults shall be rated for HS20-44 per AASHTO standard specifications.

D. Vault covers in sidewalks shall be coated with aggregated epoxy for non-slip surface.

2.04 SOURCE QUALITY CONTROL

A. Fabricate units in accordance with ACI 318 and the National Precast Concrete Association's Quality Control Manual for Precast Plants.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All joints between precast concrete vault sections shall be made watertight.

B. A plastic joint sealing compound shall be installed according to the manufacturer's recommendations to provide a watertight joint which remains impermeable throughout the design life of the structure.

C. Water testing may be required by the City in accordance with the precast concrete producer's recommendations.

****END OF SECTION****

SECTION 03600

GROUT

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Grout for uses other than masonry.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals
2. Section 03300 – Cast-in-Place Concrete
3. Section 03301 – Reinforced Concrete

1.03 QUALITY ASSURANCE

A. References

1. The publications referred to hereinafter form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and the listed standards, the requirements of this section shall prevail.

Reference	Title
ASTM C33	Concrete Aggregates
ASTM C40	Organic Impurities in Fine Aggregates for Concrete
ASTM C88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C117	Material Finer Than 75 um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C150	Portland Cement
ASTM C289	Potential Reactivity of Aggregates (Chemical Method)
ASTM C494	Chemical Admixtures for Concrete
ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
CRD-C621	Corps of Engineers Specification for Nonshrink Grout

1.04 SUBMITTALS

A. The following information shall be provided in accordance with Section 01330.

1. Manufacturer's Data:

a. Manufacturer's data shall be provided for the following:

b. Dry pack grout

c. Cement grout

d. Nonshrink grout, non-metallic

e. Nonshrink grout, metallic

f. Pressure grout

g. Epoxy grout

h. Polymer concrete

2. Laboratory Test Reports:

a. Test reports on previously tested materials shall be accompanied by the manufacturer's statement that the previously tested material is the same type, quality, manufacture, and make as that proposed for use in this project. Test reports are required for the following:

b. Cement

c. Aggregates

d. Bonding compounds

e. Admixtures

PART 2 - PRODUCTS

2.01 MATERIALS

A. Cement

1. Portland cement shall be ASTM C150 Type II or Type V, low alkali, containing less than 0.60 percent alkalies.

B. Aggregate

1. General

a. Aggregate shall be nonreactive and shall be washed before use. When sources of aggregate are changed, test reports shall be provided for the new material.

b. The tests specified shall be performed prior to commencing grout work.

2. FINE AGGREGATE:

a. Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine and shall conform to ASTM C33 as modified herein.

b. When tested in accordance with ASTM C136, gradation shall be such that 100 percent by weight will pass a standard No. 8 mesh sleeve and no less than 45 percent by weight will pass a standard No. 40 mesh sieve.

c. Variation from the specified gradations in individual tests will be acceptable if the average of three consecutive tests is within the specified limits and the variation is within the permissible variation listed below:

US standard sieve size	Permissible variation in individual tests, percent
30 or coarser	2
50 or finer	0.5

3. Other tests shall be in accordance with the following specifications:

Test	Test Method	Requirements
Organic Impurities	ASTM C40	Color lighter than standard
Amount of Material Passing No. 200 Sieve	ASTM C117	3% maximum by weight
Soundness	ASTM C88	10% maximum loss with sodium sulfate
Reactivity	ASTM C289	Innocuous aggregate
Sand Equivalent	ASTM D2419	Minimum 80

C. Admixtures

1. General

a. Admixtures shall be compatible with the grout. Calcium chloride or admixtures containing calcium chloride are not acceptable. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the grout mix.

2. Water Reducing Retarder

a. Water reducing retarder shall be ASTM C494 Type D and shall be Master Builders Pozzolith 300-R, Sika Corporation Plastiment, or equal.

3. Lubricant for Cement Pressure Grouting

a. Lubricant additive for cement pressure grouting shall be Intrusion Prepakt Intrusion Aid, Sika Intraplast N, or equal.

D. Water

1. Water for washing aggregate, for mixing and for curing shall be free from oil and deleterious amounts of acids, alkalies, and organic materials; shall not contain more than 1000 mg/1 of chlorides as Cl, nor more than 1300 mg/1 of sulfates as SO4; and shall not contain an amount of impurities that may cause a change of more than 25 percent in the setting time of the cement nor a reduction of more than five percent in the compressive strength of the grout at 14 days when compared with the result obtained with distilled water.

2. Additionally, water used for curing shall not contain an amount of impurities sufficient to discolor the grout.

2.02 GROUT

A. Drypack Grout

1. Drypack grout shall be a mixture of approximately one part cement, 1-1/2 to 2 parts sand, water reducing retarder, and sufficient water to make a stiff workable mix.

B. Cement Grout

1. Cement grout shall be a mixture of one part cement, two parts sand, proportioned by volume, admixtures for pressure grouting, and sufficient water to form a workable mix.

C. Nonshrink Grout, Non-Metallic

1. Nonshrink, nonmetallic aggregate grout shall be Five Star Products, Inc. Five Star Grout, Chemrex Inc. Masterflow 928, Euclid Chemical Co. High-Flow Grout, or equal.

2. Nonshrink Grout, Metallic

a. Nonshrink, metallic grout shall be Chemrex Inc. Embeco 636 Plus Grout, Euclid Chemical Co. High-Flow Metallic Grout, or equal.

D. Epoxy Grout for Crack Repair

1. Except as noted below, epoxy grout shall be a high modulus, two-component, moisture insensitive, 100 percent solids, thermosetting modified polyamid epoxy compound. The consistency shall be a paste form capable of not sagging in horizontal or overhead anchoring configurations. Material shall conform to ASTM C881 Type 1, Grade 3, such as Chemrex Inc. Concresive Paste LPL, Sika Corporation Sikadur Hi-Mod Series, Adhesive Technology Corporation Solidbond 200 or equal, and shall have a heat deflection temperature in excess of 130 degrees F.

2. Epoxy for pressure grouting/crack injection shall be a two-component, moisture insensitive, high modulus, injection grade, 100 percent solids, blend of epoxy-resin compounds. The consistency shall be as required to achieve complete penetration in hairline cracks and larger. Material shall conform to ASTM C881 Type 1 Grade 1, such as Sika Corporation Sikadur 52, Chemrex Inc. Concresive LV1, Adhesive Technology Corporation SLV 300 series, or equal.

E. Polymer Concrete (For Resurfacing or Patching)

1. Polymer concrete (for resurfacing or patching) shall consist of a liquid binder and dry aggregate mixed together to make a mortar or grout of a consistency as required for the application. The liquid binder shall be a chemical and oil resistant, stress relieved, low modulus, moisture insensitive, two-component epoxy-resin compound. The consistency shall be similar to lightweight oil for proper mixing with aggregate. Material shall conform to ASTM C881 Type 3 Grade 1, such as Sika Corporation Sikadur Lo-Mod series, Adhesive Engineering Concresive 1470, Adhesive Technology Corporation 400 series, or equal.

2. The aggregate shall be oven dry in sealed packages until time of mixing, and shall be of size and consistency compatible with recommendations of manufacturer of liquid binder for intended application.

2.03 PRESSURE GROUTING EQUIPMENT

A. Pressure grouting equipment shall include a mixer and holdover agitator tanks and shall be designed to place grout at pressures up to 50 psi. Gages shall be provided to indicate pressure used. The mixer shall be provided with a meter capable of indicating to one-tenth of a cubic foot the volume of grout used.

PART 3 - EXECUTION

3.01 GENERAL

A. Bonding compound for use with grout is specified in Section 03300. Primer, if required for polymer concrete, shall be provided per manufacturer's recommendation.

3.02 DRYPACK GROUT

A. Drypack grout shall be used for built-up surfaces, setting miscellaneous metal items and minor repairs.

B. Surfaces required to be built up with drypack grout shall be roughened by brushing, cleaned, and coated with the bonding compound specified in Section 03300 before the application of the grout. The drypack grout shall be applied immediately following the application of the bonding compound in bands or strips to form a covering of the required thickness. The covering shall be smooth. Construction joints in the grout shall be sloped and shall be cleaned and wetted before application is resumed. Drypack grout shall be cured in accordance with Section 03301.

C. Grout shall not be placed during freezing weather unless adequate protection is provided.

3.03 CEMENT GROUT

A. Cement grout shall be used for filling nonbearing portions of equipment pads and pressure grouting.

B. Except for the specialized equipment for pressure grouting, mixing and placing apparatus shall be similar to that normally used for cast-in-place concrete. Grout shall be mixed for a period of at least 1 minute. Diluted grout shall be agitated to keep ingredients mixed.

3.04 NONSHRINK GROUT

A. Nonshrink, metallic aggregate grout shall be used for the bearing surfaces of machinery and equipment bases, column base plates and bearing plates at dry, interior locations. Nonshrink, non-metallic aggregate grout shall be used for the bearing surfaces of machinery and equipment bases, column base plates, and bearing plates at damp or exterior locations as well as for setting handrail, guardrail, or fence posts in pipe sleeves. Grout shall meet the requirements of CRD-C621 and shall be placed in accordance with manufacturer's instructions.

3.05 EPOXY GROUT

A. Epoxy grout shall be used for repairing cracks by pressure grouting or gravity flow in structural concrete. Concrete shall be primed in accordance with the grout manufacturer's instructions.

3.06 PRESSURE GROUTING

A. Prior to grouting, systems and holes to be grouted shall be washed clean. Washing is not required for grouting soil voids outside pipe cylinders or casing pipes. Grouting, once commenced, shall be completed without stoppage. In case of breakdown of equipment, the Contractor shall wash out the grouting system sufficiently to ensure fresh grout and adequate bond and penetration will occur upon restarting the grouting operation. Grout pressure shall be maintained until grout has set.

END OF SECTION

SECTION 04200

CONCRETE MASONRY

PART 1 - GENERAL

1.01 DESCRIPTION

A. Scope: This section specifies masonry work consisting of reinforced masonry construction.

B. Type: Masonry work shall be constructed from units of concrete in combination with reinforcing, mortar, and grout as specified.

1.02 QUALITY ASSURANCE

A. References: This section contains references to the following documents. They are a part of this section as specified and modified. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASTM A82	Steel Wire, Plain, for Concrete Reinforcement
ASTM A90/A90M	Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM A153/A153M	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM C90	Loadbearing Concrete Masonry Units
ASTM C91	Masonry Cement
ASTM C129	Non-load-bearing Concrete Masonry Units
ASTM C144	Aggregate for Masonry Mortar
ASTM C150	Portland Cement
ASTM C207	Hydrated Lime for Masonry Purposes
ASTM C270	Mortar for Unit Masonry
ASTM C404	Aggregates for Masonry Grout
ASTM C476	Grout for Masonry
ASTM C666	Resistance of Concrete to Rapid Freezing and Thawing
ASTM E514	Water Penetration and Leakage Through Masonry

B. Material Consistency: Source or supply of materials shall not be changed after the work has started if the appearance of the finished work would be affected.

1.03 SUBMITTALS

A. Submit in accordance with Section 01330 – Submittals.

B. Shop drawings showing details of bond beams and lintels.

C. Full-size sample masonry unit showing full range of color, texture, finish, and dimensions shall be submitted for approval by the Engineer.

1.04 DELIVERY, STORAGE, AND HANDLING:

A. Cementitious materials shall be delivered to the site in unbroken containers, plainly marked and labeled with manufacturers' names and brands, stored in dry, weather-tight enclosures to prevent entry of foreign materials and damage by water or dampness. Masonry units shall be stored off the ground and handled with care to avoid chipping and breakage. Materials shall be protected from damage and, except for sand, kept dry until used. Sand shall be covered to prevent intrusion of water and foreign materials and to prevent drying. Materials containing frost or ice shall not be used.

PART 2 - PRODUCTS

2.01 MASONRY UNITS

A. Concrete Masonry Units

1. General: Concrete masonry units shall be of modular dimensions and air, water, or steam cured. Units shall be manufactured of split face texture and tan in color. Unless otherwise specified, interior surfaces of units shall be a ground face finish, comparatively smooth and of uniform texture. Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide a suitable bond. Where the finish surface will not be visible, masonry units shall be colored standard gray. Colorant shall be alkali-resistant iron oxide based and shall be Sonneborn "Sonobrite," Solomon Grind-Chem Service, Inc., "Concentrated Cement Color," or equal.

2. Hollow Load-Bearing Units: Hollow load-bearing units shall conform to ASTM C90, Grade N, Type I, made with lightweight or normal weight aggregate. Load-bearing units shall be provided, unless otherwise specified.

3. Hollow Nonload-Bearing Units: Hollow nonload-bearing units, where specified, shall conform to ASTM C129, Type I, made with lightweight or normal weight aggregate. Load-bearing units may be provided in lieu of nonload-bearing units.

4. Special Shapes: Special shapes such as closures, header units, and jamb units shall be provided as necessary to complete the work. Special shapes shall conform to the requirements for the units with which they are used.

B. Precast Concrete Lintels: Precast concrete lintels shall be of the same materials and surface texture as adjacent masonry units, with a 28-day compressive strength of not less than 4000 psi. Reinforcing shall be provided as specified. Lintels shall be of sizes specified, straight and true, with at least 8 inches of bearing at each end.

2.02 MORTAR

A. Cement: Cement shall be Portland cement conforming to ASTM C150, Type II, low alkali containing less than 0.60 percent alkalies.

B. Hydrated Lime: Hydrated lime shall conform to ASTM C207, Type S.

C. Masonry Cement: Masonry cement shall conform to ASTM C91, except that for masonry cement used in mortar for exterior walls, the air content of the mortar

specimen shall be not more than 16 percent by volume in lieu of 22 percent. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

D. Sand: Aggregate for mortar shall be sand conforming to ASTM C144.

E. Water: Water shall be clean, potable, and free from substances which could adversely affect the mortar.

F. Waterproofing Compound: Mortar shall contain an admixture of Master Builders Rheomix 235, Sonneborn Hydrocide Powder, or equal.

G. Mortar Types: Unless otherwise specified, mortar shall be ASTM C270, Type M for foundation and exterior walls and other load-bearing or shear-wall masonry, and Type S for nonload-bearing, nonshear-wall interior masonry. Waterproofing compound shall be added in accordance with manufacturer's recommendations. Air content shall not be less than 11 percent. Where colored mortar is specified to match the masonry units, add colorant to obtain the color indicated. Colorant shall be alkali-resistant iron oxide based and shall be Sonneborn "Sonobrite," Solomon Grind-Chem Service, Inc., "Concentrated Cement Color," or equal.

H. Premixed Mortar: Premixed mortar shall be ASTM C270, Type M or S for use as pecified in Paragraph 04200-2.02 G. Water proofing compound shall be added in accordance with manufacturer's recommendation. Air content shall not be less than 11 percent.

I. Admixtures: Admixtures may be used in mortar to retard curing and provide up to 36 hours of workability, provided that the admixture does not adversely affect bonding or compressive strength.

2.03 ACCESSORIES

A. Horizontal Joint Reinforcement: Horizontal joint reinforcement shall be fabricated from cold drawn steel wire, ASTM A82. Wire shall be hot-dipped galvanized after fabrication in accordance with ASTM A153. Reinforcement shall be truss type with two or more longitudinal wires welded to a continuous diagonal cross wire, or ladder type with perpendicular cross wires not more than 16 inches o.c. Reinforcement shall be provided in flat sections 10 feet long, and preformed corners and tees approximately 30 inches long. Overall width shall be approximately 2 inches less than nominal thickness of wall. For single-width walls and partitions, two 9-gage longitudinal wires and 9-gage cross wires shall be provided.

B. Reinforcing Bars: Reinforcing steel shall be as specified in Section 03200.

C. Anchors and Ties:

1. General: Anchors and ties shall be approved designs of stainless steel, zinc-coated steel, or noncorrosive metal having the equivalent total strength of steel types. Zinc-coated steel shall be coated by the hot-dip process after fabrication to a minimum of 1.25 ounces of zinc per square foot of surface when tested in accordance with ASTM A90.

2. Corrugated Metal Ties: Metal ties shall be not less than 7/8-inch wide by approximately 7 inches long and not lighter than 22 gage.

3. Rigid Steel Anchors: Rigid steel anchors shall be not less than 1 inch wide, 1/4-inch thick, and 24 inches long with each end bent not less than 2 inches.

4. Dovetail Flat Bar or Wire Anchors: Flat bar anchors shall be sheet steel, not lighter than 16 gage, and 7/8-inch wide, with end turned up 1/4 inch. Wire anchors shall be not lighter than 6 gage, 7/8-inch wide with wire looped and closed.

5. Dovetail Anchor Slots: Unless otherwise specified, Dovetail slots shall be made of galvanized steel with minimum dimensions of 1-inch wide back by 1 inch deep by 5/8-inch throat.

2.04 GROUT

A. General: Grout shall comply with ASTM C476, shall use Type II cement, and shall be proportioned by volume to achieve a minimum 28-day compressive strength of 3000 psi. Grout shall have sufficient water added to produce a consistency for pouring without segregation.

B. Aggregate: Aggregate shall comply with ASTM C404.

C. Fine Grout: Fine grout shall be composed of one part cement, not more than 1/10 part lime, and 2-1/4 to 3 parts fine aggregate.

D. Coarse Grout: Coarse grout shall be composed of one part cement, not more than 1/10 part lime, 2 to 3 parts fine aggregate, and not more than 2 parts coarse aggregate.

2.05 PRODUCT DATA

A. The following product data shall be provided in accordance with Section 01330 Submittals. All product data shall be received by the Engineer at least 14 days prior to the beginning of masonry work.

1. Masonry unit certificates showing compliance to the specifications shall be submitted for each type of masonry unit.

2. Reinforcing certificates showing compliance to the specifications shall be submitted for reinforcing steel, including reinforcing steel wire and joint reinforcing, as specified herein and in Section 03200.

3. Shop drawings showing details of anchors, adjustable wall ties, positioning devices, and other accessories.

4. Manufacturer's data and descriptive literature for each type of masonry accessory, premixed mortar, masonry cement, grout admixtures, and flashing. Clearly mark the data to indicate which type, size, or item the Contractor intends to provide. Data shall show conformance to specified requirements and Contractor's proposed usage details.

PART 3 - EXECUTION

3.01 PREPARATION

A. General: Foundations for masonry work shall be straight, on-line, and level. All surfaces to be bonded with masonry shall be clean and free from laitance or foreign

materials. Reinforcing dowels shall be in the correct location as specified. The placement and location of anchor ties, inserts, and other embedded items in concrete or other adjoining work shall be coordinated by the Contractor to suit the masonry work.

B. Protection:

1. Exposed surfaces shall be protected from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Base of walls shall be protected from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

2. Uniform loads shall not be applied for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed.

3. Temporary bracing shall be provided as required to prevent damage during construction.

4. Protective boards for polyester film shall be provided during job installation to ensure no damage from building debris.

3.02 WORKMANSHIP

A. Masonry shall be level and plumb. Story poles or gage rods shall be used throughout the work. Changes in coursing or bonding after the work is started will not be permitted; neither will carrying one section of the walls up in advance of the others be permitted. Unfinished work shall be stepped back for joining with new work; toothing will not be permitted. Heights of masonry at each floor and at sills and heads of openings shall be checked with an instrument to maintain the level of the walls. Door and window frames, louvered openings, anchors, pipes, ducts, and conduits shall be built in as the masonry work progresses. Spaces around metal door frames shall be filled solidly with mortar. Drilling, cutting, fitting, and patching to accommodate the work of others shall be performed by masonry mechanics. Masonry shall be cut with masonry saws for exposed work. Structural steelwork, bolts, anchors, inserts, plugs, ties, lintels, and miscellaneous metalwork shall be placed in position as the work progresses. Chases of approved dimensions for pipes and other purposes shall be provided where specified and necessary. Tops of exposed walls and partitions not being worked on shall be covered with a waterproof membrane secured in place and extended down at least 2 feet on both sides.

3.03 MORTAR MIXING

A. Mortar materials shall be measured in 1 cubic foot containers to maintain control and accuracy of proportions; measuring materials with shovels is not permitted. Mortar shall be mixed in a mechanical batch mixer for not less than 3 nor more than 5 minutes after all ingredients are in so as to produce a uniform mixture. Water shall be added gradually as required to produce a workable consistency. Mortar not formulated to include retarding admixtures, which has not been placed in final position within 2-1/2 hours after the initial mixing, shall not be retempered and used. Use of antifreeze compounds, salts, or other substances to lower the freezing point of mortar is prohibited.

B. Mortar shall be mixed in accordance with ASTM C270 to obtain type mortar required. Where colored mortars are required, pigments may be added at the site

or provided as part of prepackaged mortar mix. When masonry cement is used, mixing shall conform to printed instructions of the masonry cement manufacturer.

3.04 MORTAR JOINTS

A. Mortar joints shall be a uniform thickness of 3/8-inch unless otherwise specified. Exposed joints shall be tooled slightly concave with a round or other suitable jointer when the mortar is thumbprint hard. For horizontal joints, jointers shall be at least 16 inches long for concrete masonry. Jointers shall be slightly larger than the width of the joint so that complete contact is made along the edges of the units, compressing and sealing the surface of the joint. Joints that will not be exposed shall be struck flush. Vertical joints shall be tooled first. Horizontal joints shall be level; vertical joints shall be plumb and in alignment from top to bottom of wall within a tolerance of plus or minus 1/2 inch in 40 feet.

3.05 TOLERANCES

A. Masonry work shall be within the following limits:

1. Pilasters and Columns: 1/4 inch from true line.
2. Face of Concrete Masonry Unit: 1/16 inch from face of adjacent unit.
3. Variation from True Plane: 1/4 inch in 10 feet and 1/2 inch maximum in 20 feet or more.
4. Variation from Plumb: 1/4 inch in each story, noncumulative and 1/2 inch maximum in two stories or more.
5. Variation from Level: 1/8 inch in 3 feet, 1/4 inch in 10 feet, and 1/2 inch maximum.
6. Variation in Wall Thickness: Plus or minus 1/4 inch.

3.06 CONCRETE MASONRY UNIT WORK

A. General: The first course shall be laid in a full bed of mortar for the full width of the unit. Succeeding courses shall be laid in running bond unless otherwise specified. Bed-joints shall be formed by applying the mortar to the entire top surfaces of the inner and outer face shells and to head joints by applying the mortar for a width of about 1 inch to the ends of the adjoining units. The mortar shall be of such thickness that it will be forced out of the joints as the units are placed in position. Where anchors, bolts, and ties occur within the cells of the units, metal lath shall be placed in the joint at the bottom of such cells and the cells filled with mortar or grout as the work progresses. Except at grouted or reinforced masonry, concrete brick shall be used for bonding walls, working out the coursing, topping out walls under sloping slabs, distributing concentrated loads, backing brick headers, and elsewhere as required. Concrete masonry units shall not be dampened before or during laying.

B. Special Concrete Masonry Unit Work: Where exposed concrete masonry unit walls and partitions are specified, special concrete masonry unit work shall be provided. Units shall be selected for uniformity of size, texture, true plane, and undamaged edges and ends of exposed surfaces. Units shall be placed plumb, parallel, and with properly tooled joints of maximum 3/8-inch thickness, and exposed surfaces kept clean and free from blemishes or defects.

C. Reinforced Concrete Masonry Unit Walls: Where vertical reinforcement occurs, cores shall be filled solid with grout, and units laid in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Adjacent webs shall be embedded in mortar to prevent leakage of grout, and mortar fins protruding from joints removed before grout is placed. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Reinforcing shall be positioned and held accurately before placing grout by tying or by using bar positioners at maximum 8-foot intervals. Vibrator shall be used to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be 1/2 inch. Unless otherwise specified, splices shall be formed by lapping bars not less than 40 bar diameters.

3.07 BONDING AND ANCHORING

A. Unless otherwise specified, partitions shall extend from the floor to the bottom of the construction above. Walls and partitions shall be structurally bonded and anchored to each other and to concrete walls and beams. Unless otherwise specified, nonload-bearing partitions and interior walls shall be securely anchored to the construction above in a manner that provides lateral stability while permitting unrestricted deflection of construction above. Anchors shall be completely embedded in mortar joints.

B. In addition, bonding and anchoring shall comply with the following procedures unless otherwise specified:

1. At corners of load-bearing walls, provide a true masonry bond in each course.

2. At intersections of load-bearing walls, provide a true masonry bond in each course, or anchor with rigid steel anchors not more than 2 feet apart vertically.

3. At intersections of non-load-bearing partitions with other walls or partitions, tie with wire mesh ties at vertical intervals of not more than 2 feet or with masonry bonding in

4. At masonry walls facing or abutting new concrete members, anchor masonry to the concrete with dovetail or wire-type anchors inserted in slots or inserts built into the concrete. To anchor masonry walls to existing concrete members, use corrugated metal ties anchored by drive pins to the concrete. Locate anchors not more than 18 inches o.c. vertically and not more than 24 inches o.c. horizontally.

3.08 HORIZONTAL JOINT REINFORCEMENT

A. Unless otherwise specified, reinforcement shall be provided at 16-inch spacing in all masonry walls. Reinforcement shall be continuous except at control joints and expansion joints. Reinforcement above and below openings shall extend not less than 24 inches beyond each side of openings. Reinforcement shall be provided in the longest available lengths, utilizing the minimum number of splices. Welded L-shaped assemblies and welded T-shaped assemblies to match the straight reinforcement shall be provided at corners and intersections of walls and partitions.

3.09 CONCRETE MASONRY UNIT LINTELS AND BOND BEAMS

A. Special units, lintels, and bond beams shall have cells filled solidly with grout or concrete, and provided with not less than two No. 5 reinforcing bars, unless otherwise specified. Reinforcing shall overlap a minimum of 40 bar diameters at splices. Bond beams and reinforcing shall terminate on each side of expansion joints. Concrete masonry units used for lintels and bond beams shall have exposed surfaces of the same material and texture as the adjoining masonry units. Bond beam units shall be produced from standard vertically-voided units with precut knock-out cross walls. Lintels shall be straight and true and shall have at least 8 inches of bearing at each end. Lintels shall set at least 6 days before shoring is removed.

3.10 GROUT

A. General: Fine grout shall be provided in grout spaces which are less than 2 inches in any horizontal dimension after deducting the thickness of horizontal reinforcing or in which clearance between reinforcing and masonry is less than 3/4 inch. Coarse grout shall be provided in grout spaces which are 2 inches or greater in all horizontal dimensions after deducting the thickness of horizontal reinforcing provided the clearance between reinforcing and masonry is not less than 3/4 inch. For a coarse grout pour over 6 feet high, increase grout space minimum horizontal dimension to 3 inches.

B. Placement: Grout shall be placed from the interior side of walls, except as approved otherwise. Sills, ledges, offsets, and other surfaces shall be protected from grout droppings. Prior to grouting, the grout space shall be clean so that all spaces to be filled with grout do not contain mortar projections greater than 1/2 inch, mortar droppings, or other foreign material. Grout shall be well mixed to prevent segregation, shall be sufficiently fluid to flow into joints and around reinforcing without leaving voids, and shall be placed by pumping or pouring from buckets equipped with spouts. Grout shall be placed in a continuous pour in grout lifts not exceeding 6 feet. At grout pours exceeding 6 feet, cleanouts shall be provided in the bottom course at every vertical bar but shall not be spaced more than 32 inches on center for solidly grouted masonry. Pours shall be 1-1/2 inches below the top of masonry units in top course, except at the finish course. Grout shall be agitated thoroughly to eliminate voids. Masonry displaced by grouting operation shall be removed and relaid in alignment with fresh mortar.

3.11 FORMS AND SHORING

A. Contractor shall construct forms to the shape, lines, and dimensions of members indicated and make sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry. Forms shall not be removed until members have cured.

3.12 PARGING

A. Contractor shall parge the outside of masonry basement walls in contact with the earth with two coats of Type M mortar (paragraph 04200-2.02 G), each 3/8-inch thick. The first coat shall be cross-scratched and allowed to cure at least 24 hours. The second coat shall be trowelled smooth, bevelled at top, and coved out to edge of footing. Parging shall extend not more than 4 inches above grade, unless otherwise specified, and kept damp for at least 3 days.

3.13 CLEANING

A. Contractor shall protect work which may be damaged, stained, or discolored during cleaning operations.

B. Exposed masonry surfaces shall be cleaned with clear water and stiff fiber brushes and rinsed with clear water. Where stains, mortar, or other soil remain, scrubbing shall continue with warm water and detergent. Immediately after cleaning, each area shall be rinsed thoroughly with clear water. Damaged, stained, and discolored work shall be restored to original condition or replaced with new work.

3.14 COLD WEATHER CONDITIONS

A. Construction: During cold weather, that is, when the air temperature is below 40 degrees F and falling, or when it appears that the air temperature will drop to 40 degrees F or below within 24 hours, Contractor shall not lay masonry unless the work is protected from freezing as specified below. Surfaces receiving mortar shall be free of ice and frost. The following requirements shall be adhered to:

1. Air temperature 40 to 32 Degrees F: Heat sand or mixing water to produce mortar temperature between 40 and 120 degrees F.

2. Air Temperature 32 to 25 Degrees F: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F.

3. Air Temperature 25 to 20 Degrees F: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F. Use other heat sources on both sides of walls under construction. Use windbreaks when wind is in excess of 15 mph.

4. Air Temperature 20 Degrees F and Below: Heat sand and mixing water to produce mortar temperature between 40 and 120 degrees F. Provide enclosures and auxiliary heat to maintain air temperature above 32 degrees F on both sides of walls under construction. Ascertain that temperatures of masonry units are not less than 20 degrees F when units are laid.

B. Protection: Newly laid masonry shall be protected as specified below for the respective mean daily air temperature (MDAT), that is, the average of the daytime high temperature and the forecasted nighttime low temperature:

1. MDAT 40 to 32 degrees F

   a. Protect masonry from rain and snow by covering the top 4 feet with weather-resistive membrane for 24 hours after laying.

2. MDAT 32 to 25 degrees F

   a. Completely cover newly laid masonry with weather-resistive membrane for 24 hours.

3. MDAT 25 to 20 degrees F

   a. Completely cover newly laid masonry with insulating blankets and weather-resistive membrane for 24 hours.

4. MDAT 20 degrees F and Below

a. Maintain temperature of masonry above 32 degrees F for 24 hours by providing enclosures and supplementary heat or other approved means.

END OF SECTION

SECTION 05100

STRUCTURAL METALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies structural metals consisting of standard shapes, fasteners, rods and plates that are used in structural supports and connections.

1.02 QUALITY ASSURANCE

A. General: Structural assemblies and shop and field welding shall meet the requirements of the AISC Manual of Steel Construction.

B. The use of salvaged, reprocessed or scrap materials shall not be permitted.

C. References: This section contains references to the following documents. They are a part of this section as specified and modified. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
AISC	Manual of American Institute of Steel Construction Construction, Manual of Steel Construction, Allowable Stress Design - 9th Edition
ASTM A36/A36M	Structural Steel
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A283/A283M	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A307	Carbon Steel Externally Threaded Standard Fasteners
ASTM A320/ A320M	Alloy-Steel Bolting Materials for Low Temperature Service
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A666	Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar for Structural Applications
ASTM B308	Aluminum-Alloy Standard Structural Shapes, Rolled or Extruded
AWS-B3.0	Welding Procedures and Performance Qualifications
AWS-DI.1	Structural Welding Code--Steel

1.03 SUBMITTALS

A. Submittals shall be provided in accordance with Section 01330 Submittals and shall indicate the following information.

B. Detailed shop drawings of steel frame for the fabrication of the component parts of all structures. Submittals shall include the location, type and size of all bolts and

welds. All welds shall be indicated by standard welding symbols of the AWS. Indicate length of welds. The member cambers shall be indicated on the drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel

1. Materials for structural metals shall be as specified below.

Material	Specification
Standard rolled steel sections	ASTM A36
Pipe columns	ASTM A53, Grade B
Structural steel tubing	ASTM A500, Grade B
Structural bars, plates, and similar items	ASTM A36 or A283
Stainless steel	ASTM A666, Grade A, type 304 or Type 316
Stainless steel bolts, nuts, and washers	ASTM A320, type 316
Steel bolts	ASTM A307, Grade A

B. Aluminum

1. Unless otherwise specified, aluminum shall be extruded from 6061-T6 or 6063-T6 alloy, conforming to ASTM B308.

2.02 FABRICATION

A. Fabrication shall be in accordance with the AISC Manual of Steel Construction.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Measurements shall be verified at the job.
2. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or drilled. No drifting of bolts nor enlargement of holes will be allowed to correct misalignment. Mismatched holes shall be corrected with new material.
3. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. Aluminum in contact with concrete or grout shall be protected with a heavy coat of bituminous paint.
4. Metalwork to be embedded in concrete shall be as specified in Section 03301. Metalwork shall be placed accurately and held in correct position while the concrete is placed or, if specified, recesses or blockouts shall be formed in the concrete after design strength is attained, and the metalwork shall be grouted in place in accordance with Section 03300. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned.

5. Structural steel completely encased in concrete shall not be galvanized or painted and shall have a clean surface for bonding to concrete. Metalwork which is bent, broken or otherwise damaged shall be repaired or replaced by the Contractor.

B. Welding

1. Welding shall be done by operators who have been qualified by tests as prescribed by AWS WI Sect. 7 to perform the type of work required. The quality of welding shall conform to AWS Code for Arc Welding in Building Construction Section 4, Workmanship.

2. Unless otherwise specified, continuous welds shall be provided on all structural members that are exposed to weather or submerged in water or wastewater, and continuous seal welds shall be provided on both sides of all plates or structural shapes that are in contact with or submerged in water or wastewater.

C. Bolted Connections: Bolted connections shall conform to AISC Framed Beam Connections and shall be bearing type connections with threads excluded from shear planes.

3.02 CORROSION PROTECTION

A. Unless otherwise specified, all structural metal and structural steel, including that used in the fabrication of process equipment, shall be coated in accordance with Section 05910 Hot Dip Zinc Coating or Section 09900 Coating Systems.

3.03 CLEANING

A. After installation, damaged surfaces of shop primed metals shall be cleaned and touched up with the same material used for the shop coat. Damaged surfaces of galvanized metals shall be repaired as specified in Section 05910 Hot-Dipped, Zinc-Coating.

END OF SECTION

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SECTION 05220

ALUMINUM HANDRAILS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Aluminum Handrails.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01330 – Submittals
2. Section 05501 – Anchor Bolts

1.03 PERFORMANCE REQUIREMENTS

A. Design railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

B. Aluminum Handrails: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.

1. Structural Performance: Provide railings capable of withstanding the following loads and stresses:

a. Handrails:

b. Uniform load of 50 pounds per lineal foot applied in any direction.

c. Concentrated load of 200 pounds applied in any direction at any point.

d. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:

a. Uniform load of 50 pounds per lineal foot applied horizontally and concurrently with 100 pound load applied vertically downward.

b. Concentrated load of 200 pounds applied in any direction at any point.

c. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movement: Provide exterior railings that allow for thermal movements resulting from a change in surface temperature of 120 degrees.

D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 SUBMITTALS

A. Comply with Section 01330.

B. Product Data: Manufacturer's standard catalog data for mechanically connected railings.

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

D. Calculations: Structural analyses signed and sealed by the Professional Civil Engineer registered in the State of California who is responsible for their preparation.

E. Samples for selection of surface color or texture.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

G. Anchor bolt calculations per Section 05501.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication. Indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: One of the following or equal:

1. Aluminum Pipe and Tube Railings:

a. AlumaGuard Corp.

b. CraneVeyor Corp.

c. Moultrie Manufacturing Company.

2.02 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

2.03 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Bars and Tubing: ASTM B 221, Alloy 6-T5/T52.

C. Extruded Structural Pipe and Round Tubing: ASTM B 429, Alloy 6063-T6.

1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.

D. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.

E. Plate and Sheet: ASTM B 209, Alloy 6061-T6.

F. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.

G. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.04 FASTENERS

A. General: Type 316 stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Anchors: Provide epoxy or expansion-type anchors, fabricated from Type 316 stainless steel with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

2.05 FABRICATION

A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections, unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.

J. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

K. Form changes in direction by bending or by inserting prefabricated elbow fittings.

L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

N. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

O. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

2.06 FINISHES, GENERAL

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Finishes

1. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.02 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.

C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.

3.03 ANCHORING POSTS

A. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.

B. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.04 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at project completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work.

END OF SECTION

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SECTION 05501

ANCHOR BOLTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies anchor bolts complete with washers and nuts. Unless otherwise specified, anchor bolts shall be galvanized or type 304 stainless steel.

1.02 REFERENCES

A. This section contains references to the following documents. They are a part of this section as specified and modified. The latest edition of referenced publications in effect at the time of the bid shall govern. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ANSI A58.1	Minimum Design Loads for Buildings and Other Structures
ASTM A36/A36M	Structural Steel
ASTM A307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A320/A320M	Alloy-Steel Bolting Materials for Low Temperature Service
UBC-97	Uniform Building Code

1.03 SUBMITTALS

A. Submittals shall be provided in accordance with Section 01330 Submittals and shall indicate the following information; type, size and number of anchors and washers for each application, materials of construction and layout; and the following information:

1. Data indicating load capacities.
2. Chemical resistance.
3. Temperature limitations.
4. Installation instructions.

PART 2 - PRODUCTS

2.01 GENERAL

A. Anchor bolt holes in equipment support frames shall not exceed the bolt diameters by more than 25 percent, up to a limiting maximum oversizing of ¼ inch. Unless otherwise specified, minimum anchor bolt diameter shall be ½ inch. Anchor bolts for equipment mounting and vibration isolation systems shall be provided.

B. Tapered washers shall be provided where mating surface is not square with the nut.

C. Expansion, wedge, or adhesive anchors set in holes drilled in the concrete after the concrete is placed will not be permitted in substitution for anchor bolts except where otherwise specified. Upset threads shall not be acceptable.

2.02 MATERIALS

A. Anchor Bolts (Cast-in-Place):

1. Bolts: ASTM A307 (Carbon Steel) for interior exposure; ASTM A276 (Stainless Steel), Type AISI 304 for exterior exposure and where otherwise noted on Drawings. Use 5/8” minimum, L-shaped hook, typical, unless otherwise noted.

2. Nuts: ASTM A563, Hex or heavy hex for ASTM A307 bolts; ASTM F594 for use with ASTM A276 bolts.

3. Washers: Same materials as bolts.

B. Expansion Anchors:

1. Steel Expansion Anchors

a. Expansion Anchors shall be stud type with an expansion system consisting of a pair of interlocking wedges or a single piece three section wedge. Anchor body shall be one piece with a length identification code.

b. Carbon steel expansion anchor components shall be plated in accordance with ASTM B633, SC9, Type III.

c. Stainless Steel expansion anchor components shall be manufactured from Type 304 stainless steel.

d. Anchors must meet the description in FS S325, Group II, Type 4, Class I for concrete expansion anchors.

e. 5/8” minimum, except as indicated on the Drawings.

f. Use carbon steel for interior exposure; use stainless steel for exterior exposure and where noted on the Drawings.

2. Acceptable Manufacturers

a. Hilti Corporation: KWIK-BOLT II (ICBO 4627) and HSL (ICBO 3987) located as noted on the Drawings.

b. Or approved equal: Submit ICBO Evaluation Report.

C. Adhesive Anchors

1. Adhesive

a. The adhesive used shall be two component, structural grade epoxy material which meets the requirements of ASTM C881, Types I, II, IV, and V, Grade 3, Classes B and C.

b. The epoxy shall be an odorless amine based resin supplied in a two component dispensing system which keeps the resin and hardener separated until they are dispensed.

c. The epoxy base resin and hardener shall be mixed in a 1 to 1 ratio through a motionless static mixing nozzle approved by the manufacturer of the system.

2. Anchor Rods

a. Anchor rods shall consist of threaded rod meeting the requirements of ASTM A36 for interior exposure and ASTM A276, Type 304, stainless steel, for exterior exposure and where noted on the Drawings.

3. Acceptable Manufacturers

a. Hilti Corporation: HIT HY 150 (ICBO 5193).

b. Hilti Corporation: HVA capsule anchor system.

PART 3 - EXECUTION

3.01 GENERAL

A. Fieldwork, including cutting and threading, shall not be permitted on galvanized items. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. Grouting of anchor bolts with nonshrink or epoxy grouts, where specified, shall be in accordance with Section 03600.

3.02 CAST-IN-PLACE ANCHOR BOLTS

A. Anchor bolts to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if specified, recesses or blockouts shall be formed in the concrete and the metalwork shall be grouted in place in accordance with Section 03300. The surfaces of metalwork in contact with concrete shall be thoroughly cleaned.

B. After anchor bolts have been embedded, their threads shall be protected by grease and the nuts run on.

3.03 ADHESIVE ANCHOR BOLTS

A. Use of adhesive or capsule anchors shall be subject to the following conditions:

1. Use shall be limited to locations where exposure, on an intermittent or continuous basis, to acid concentrations higher than 10 percent, to chlorine gas, or to machine or diesel oils, is extremely unlikely.

2. Use shall be limited to applications where exposure to fire or exposure to concrete or rod temperature above 120 degrees F is extremely unlikely. Overhead applications (such as pipe supports) because of the above concerns, shall be disallowed.

3. Approval from Construction Manager for specific application and from supplier of equipment to be anchored, if applicable.

4. Anchor diameter and grade of steel shall be per contract documents or per equipment supplier specifications. Anchor shall be threaded or deformed full length of embedment and shall be free of rust, scale, grease, and oils.

5. Embedment depth shall be as specified. Adhesive capsules of different diameters may be used to obtain proper volume for the embedment, but no more than two capsules per anchor may be used. When installing different diameter capsules in the same hole, the larger diameter capsule shall be

installed first. Any extension or protrusion of the capsule from the hole is prohibited.

6. All installation recommendations by the anchor system manufacturer shall be followed carefully, including maximum hole diameter.

7. Holes shall have rough surfaces, such as can be achieved using a rotary percussion drill.

8. Holes shall be blown clean with compressed air and be free of dust or standing water prior to installation.

9. Anchor shall be left undisturbed and unloaded for full adhesive curing period.

10. Concrete temperature (not air temperature) shall be compatible with curing requirements of adhesives per adhesive manufacturer. Anchors shall not be placed in concrete below 25 degrees F.

3.04 EXPANSION ANCHORS

A. Use of expansion or wedge type anchors shall be subject to Conditions B, C, D, F, G, and H specified in Paragraph 05501-3.03.

B. The Contractor shall supply the Construction Manager with the current evaluation report from the International Conference of Building Officials for the particular brand of expansion anchors to be used.

END OF SECTION

SECTION 05502

RESERVOIR METAL WORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work included under this section consists of furnishing all material, supplies, equipment, tools, transportation and facilities and performing all labor and services necessary for, required in connection with or properly incidental to furnishing and installing miscellaneous metal for the concrete reservoir, as described in this section of the specifications, shown on the accompanying Plans, or reasonably implied therefrom.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01330 – Submittals
2. Section 05220 – Aluminum Handrails
3. Section 09900 – Coating System

1.03 SUBMITTALS

A. Comply with Section 01330

B. Certified test reports. Before delivery of any miscellaneous metalwork, the Contractor shall provide certificates which attest to their material compliance with these specifications.

C. Layout or installation shop drawings for all miscellaneous metals, including but not limited to, seat angles, brackets, flashing, pipe supports.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Stainless steel plates and angles: ASTM A666, Grade A, type 304L, unless otherwise shown.

B. Stainless steel hardware: ASTM A320, Type 316.

C. Welding Materials: AWS D1.1; type required for materials being welded.

2.02 FABRICATION

A. Conform to Chapter 22, California Building Code; 2010 Edition (CBC).

B. Welding: Welder qualification requirements, welding procedures, etc. according to AWS D1.1-Structural Welding Code. Employ only certified welders. All butt welds shall be full penetration welds unless otherwise noted. Arc welding electrodes shall be E70 Series. All welds on hand and guardrails are to be ground smooth. Tie plates shall be welded as shown on the Plans.

C. Holes for bolts shall be punched or drilled 1/16-inch larger than normal bolt. Holes in column base plates may be 5/16-inch larger than anchor bolt diameter only if washers field welded to the base plate are provided under the nuts.

2.03 ACCESS DOORS

A. Exterior type waterproof, Aluminum 6061 T6, double-leaf over 3 feet in width and single-leaf 3 feet and under in width, traffic rated in paved areas and where shown. Where traffic loads are not required, the design live load shall be 300 pounds per square foot.

B. Component Fabrication

1. Access Door Leaf(s): 1/4-inch minimum diamond pattern plate with reinforcing on underside to withstand 300 lb. live load per sf.

2. Channel Frame: 1/4-inch with full anchor flange around perimeter.

3. Equip door(s) with heavy forged brass or stainless steel hinges with stainless steel pins. Provide stainless steel cover bolts to prevent rattling and door vibration. Provide flush aluminum drop handle.

4. Hinges: Through-bolt to cover with tamper-proof stainless steel bolts or “lock bolts” to resist vandalism, and through-bolted to frame with stainless steel bolts and fiber locknuts.

5. Equip doors with fully enclosed and lubricated compression springs with lower enclosing telescopic tube locked into supporting “boot” firmly attached to frame to retard downward motion of door leaves or corrosion-resistant stainless steel gas springs designed to limit to 17 pounds the lifting force required to open.

6. Equip doors with hold-open arm with positive locking device with conveniently positioned release handle for easy and controlled closing.

7. Furnish stainless steel snap lock mounted on bottom of leaf with removable topside handle and socket recessed in cover and provided with threaded plug for flush surface with handle removed.

8. Locate 1½-inch drainage coupling in one corner of channel frame.

9. Hardware: AISI Type 304 stainless steel.

10. Equip with recessed hasp for padlock that is covered by a hinged lid flush with the surface.

11. All access hatches shall be provided with underlying fiberglass safety grates to allow inspection of the vault while providing fall-through protection. Provide stainless steel grate where shown. Safety grates shall be designed to withstand a live load of 300 lb/ft2 with a maximum deflection of 1/150 of the span. Openings between flat bars shall be not less than 3” x 3” to facilitate visual inspection. Grates shall be provided with a hinging system that will lock the grate in the 90° open position. Each grate shall be provided with an open arm with red vinyl grip. Safety grates shall be safety orange.

C. Manufacturers: USF Fabrication, Hialeah, Florida; Bilco Co., New Haven, CT; Thompson Fabricating Co., Birmingham, AL.; or Equal.

2.04 VAULT LADDER

A. Material: Galvanized steel.

B. Fabrication

1. Fabricate ladders with rails and rungs to meet applicable requirements of OSHA, CFR Part 1910.27, and ANSI A14.3.
2. Concentrated load of 250 pounds plus 30 percent impact on rungs. Maximum rung deflection of l/360.
3. Punch rails, pass rungs through rails, and weld on outside.
4. Weld brackets to the ladder for fastening ladder to wall.

C. Pull-Up Handrail

1. Telescoping handrail, spring balanced and automatically locking in the raised position, with release lever for unlocking.
2. Manufacturer and Product: Lane International Corp. Tualatin, Oregon, or equal.

2.05 WATER TANK SECURITY HATCHES

A. Exterior type, waterproof roof hatch, 1/4” minimum aluminum 6061 T6 diamond pattern plate with reinforcing on underside to withstand 300 lb. live load per square foot.

B. Channel Frame: 3/8-inch with full anchor flange around perimeter.

C. Equip door(s) with heavy forged brass or stainless steel hinges with stainless steel pins. Provide stainless steel cover bolts to prevent rattling and door vibration. Provide flush Aluminum drop handle.

D. Hinges: Through-bolt to cover with tamper-proof stainless steel bolts or “lock bolts” to resist vandalism, and through-bolted to frame with stainless steel bolts and fiber locknuts.

E. Equip doors with fully enclosed and lubricated compression springs with lower enclosing telescopic tube locked into supporting “boot” firmly attached to frame to retard downward motion of door leaves or corrosion-resistant stainless steel gas springs designed to limit to 17 pounds the lifting force required to open.

F. Equip doors with hold-open arm with positive locking device with conveniently positioned release handle for easy and controlled closing.

G. Furnish stainless steel snap lock mounted on bottom of leaf with interior and topside handle.

H. Hardware: AISI Type 316 stainless steel.

I. Provide internal mounting, weather seal gasket and exterior padlock lugs.

J. Cover shall as manufactured by USF Fabrication, Model SRR Series Reservoir Hatch, or equal.

2.06 PORTABLE CRANE

A. Portable crane with adjustable boom and adjustable height while under load with ratchet style screw jack. Crane shall rotate 360° on a pin and sleeve bearing in the base and break down for easy storage or transport.

B. Galvanized steel construction, rated for 500 pounds capacity. Zinc plated worm gear hand winch with brake for load control. Quick disconnect anchor for attaching or removing wire rope. Independent pedestal base for upright mount.

C. Supply 45 feet of ¼ inch wire rope and swivel hook with swaged ball fittings, and plastic base cover.

D. Supply stainless steel mount sleeve and cap.

E. Crane shall be as manufactured by Thern, Series 5110, or equal.

2.07 OVERFLOW

A. The overflow pipe shall be rigidly attached to the tank and be constructed with butt-welded joints. The overflow shall consist of an approved weir box fabricated of ¼-inch thick stainless steel plate of type indicated to provide for continuous overflow of at least 8,000 gpm and overflow pipe of type and minimum diameter indicated.

2.08 EXTERIOR WATER TANK LADDER

A. Each tank shall have an approved shell ladder extending from 12 inches above the top of the foundation to 42 inches above the ladder platform. The side rails shall not be less than two inches by 3/8 inches with spacing between side rails not less than 21 inches. The rungs shall not be less than one-inch round or square bars, spaced 12 inches apart on centers. The exterior ladder shall be aluminum meeting the current OSHA requirements and Section 05220 requirements.

B. An aluminum safety cage and vandal deterrent shell shall be installed on the shell ladder with the low end of the vandal deterrent 2 inches above the bottom rung of the shell ladder. Additional ¼ -inch steel plates shall be welded to the ladder braces adjacent to the vandal deterrent, so as to fill the area between the ladder side rails and the structure for the length of the ladder gate. All intersections between these plates and the ladder side rails, ladder brackets, and the tank structure shall be seal welded. The vandal deterrent shall be equipped with a hasp for a padlock. The Contractor shall lock the vandal deterrent at the completion of the work, using a padlock furnished by the City. Manufactured ladder vandal deterrent shall be installed in accordance with manufacturer's instructions and recommendations.

2.09 INTERIOR WATER TANK LADDER

A. Interior ladder shall extend from the bottom of tank to the roof hatch. The side rails shall be stainless steel pipe with spacing between side rails not less than 21 inches. The rungs shall not be less than one-inch round or square bars, spaced 12 inches apart on centers. The inside ladder shall be constructed of stainless steel, ASTM A320, type 304L.

2.10 LADDER SAFE-CLIMBING DEVICES

A. Approved safe-climbing devices shall be rigid rail devices that meet OSHA Regulation 1910.27 and CAL-OSHA. Devices shall be installed in accordance with manufacturer's instructions and recommendations.

1. Provide tubular steel safe-climbing device as follows. The acceptable safe-climbing device is: SAF-T-CLIMB fall Prevention System, Notched Rail as manufactured by North Safety Products, Brea CA, or DBI Sala.

2. Main Components: Saf-T-Lok sleeve, the Saf-T belt and harness, and the Saf-T notch carrier rail.

3. Requirements: The safe-climbing device rail shall deflect less than 1/8 inch when subjected to the weight of a 250-pound person leaning back on the ladder, supported only by the device and the rail.

4. Fasteners: All mounting hardware shall be of the material recommended and supplied by the manufacturer of the safe-climbing device. Any fasteners damaged during the installation of the device shall be replaced by the Contractor at no cost to the City.

5. Belts, Sleeves, and Lanyards: Two belts and trolleys or sleeves shall be furnished. Also to be furnished are two 6 ft. long lanyards per belt with a snap hook with a 1 ¼-inch to 1 ½-inch wide opening on one end and a snap hook to attach to the belt on the other end.

6. Self Retracting Lifeline – Aluminum construction, 45 foot wire rope cable, with harness mount, 400 pound capacity,

7. Interior Ladder - A new tubular steel safe-climbing device shall be installed from 36 inches above the bottom to the top of the interior ladder, and equipped with a pull-up handrail per paragraph 2.04 C extending 42 inches above the roof.

8. Exterior Ladder - A new tubular stainless steel safe-climbing device shall be installed from 36 inches above the ground to the top of the ladder and extending 48 inches above the roof.

2.11 HANDRAILS

A. 42-inch high handrails with two mid-rails and toe board. Opening heights between the handrail, mid-rail, and toe bar shall not exceed 12 inches. Handrails shall be standard 1½-inch diameter aluminum pipe handrail meeting the current OSHA requirements and Section 05220 requirements.

2.12 VENT SECURITY SHROUD

A. Vent shall be constructed of 5052 aluminum and shall be constructed to prevent entrance of birds, insects, or foreign materials. Vent shall be easily dismantled for cleaning and designed to fit on straight pipe or pipe flange as shown on Plans.

B. Provide rubber gasket between vent and tank vent pipe.

C. Where stainless steel bolts are in contact with dissimilar metals use insulating sleeves and phenolic washers.

D. Vent shall be screened with either aluminum or 316/317 stainless steel mesh screen.

E. Vent shall have locking mechanism to prevent unauthorized access into tank.

F. The vent shall have the capacity to pass air so that excessive pressure is not developed at a flow either into or out of the tank of 8,000 gpm. The overflow pipe shall not be considered a tank vent.

G. Vent shall be manufactured by ARC^3 Corp., Advance Tank Construction, or equal.

2.13 QUICK OPENING MANWAY

A. Handwheel operated, open into the reservoir, with dished head against a liquid tight replaceable gasket, and rated at 50 psi minimum. Constructed of 304L stainless steel and EPDM gasket suitable for potable water. Manway shall be suitable for installation in a concrete tank with stainless steel grout ring.

B. Manway shall be as manufactured by Chase Associates, Edgecomb, Maine, Model CM-1; or equal.

2.14 SAFETY TETHER

A. Provide two tie-off plates rated at 5,000 lb each for anchoring fall-arrest systems. Bolt to roof plate where shown with roof reinforcement plates as required by tank designer. Tie-off plates shall be Item No. 13207 as manufactured by Unique Concepts Ltd., Winnipeg, MB, or equal.

2.15 ALUMINUM GRATING

A. Aluminum grating bearing bars and aluminum floor plates and cover plates shall be of alloy 6061 T6 conforming to ASTM B221. Aluminum grating cross bars shall be of an alloy conforming to either ASTM B221 (extrusions) or B210 (drawn).

B. Unless otherwise specified, grating shall be fabricated of aluminum. Both bearing bars and cross bars shall be continuous. Openings shall be banded with bars having the same dimensions as the bearing bars. No single piece of grating shall weigh more than 80 pounds unless specifically detailed otherwise. Aluminum grating shall be Gary Galok, Seidelhuber, or equal.

C. Seat angles and all grating supports set in concrete shall be stainless steel: ASTM A193 and ASTM A194, Type 316. Perimeter edges shall be banded with bars flush at the top surface of the grating and 1/4 inch clear of the bottom surface.

PART 3 - EXECUTION

3.01 STEEL ERECTION

A. Erect structural steel in accordance with AISC Specification.

B. Make provision for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection and installation of permanent bracing.

C. Do not field cut or alter structural members without approval of Engineer.

D. After erection, prime welds, abrasions, and surfaces not shop primed, galvanized, except surfaces to be in contact with concrete. Use a primer consistent with shop coat. Use primer recommended for galvanized surfaces.

E. Bolting: Securely bolt or weld the work as erection progresses to provide for all dead load, lateral forces and erection stresses.

3.02 MISCELLANEOUS METALWORK

A. General

1. Fieldwork shall not be permitted on galvanized items. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.

2. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings and isolators. Aluminum in contact with concrete shall be protected by a heavy coat of bituminous paint.

3. Metalwork to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if specified, recesses or blockouts shall be formed in the concrete. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned. If accepted, recesses may be neatly cored in the concrete after it has attained its design strength and the metalwork grouted in place.

B. SEAT ANGLES, SUPPORTS, AND GUIDES

1. Seat angles for grating and supports for floor plates shall be set so that they are flush with the floor and also maintain the grating and floor plates flush with the floor.

C. FABRICATION

1. Holes shall be punched 1/6-inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.

2. Fabrication including cutting, drilling, punching, threading and tapping required for miscellaneous metal or adjacent work shall be performed prior to hot-dip galvanizing.

D. All fasteners for aluminum shall be stainless steel. All steel other than stainless steel shall be isolated from aluminum with stainless steel, neoprene, or other approved material.

3.03 COATING REQUIREMENTS

A. Coatings shall conform to Section 09900.

3.04 CLEANING

A. After installation, damaged surfaces of shop primed metals shall be cleaned and touched up with the same material used for the shop coat.

END OF SECTION

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SECTION 05505

MISCELLANEOUS METALWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies miscellaneous metalwork, which consists of custom fabricated steel metalwork other than structural metalwork.

1.02 QUALITY ASSURANCE

A. General:

1. Shop and field welding shall conform to the requirements of the AISC Manual of Steel Construction.

2. The use of salvaged, reprocessed or scrap materials will not be permitted.

B. References:

1. This section contains references to the following documents. They are a part of this section as specified and modified. The latest edition of referenced publications in effect the time of the bid shall govern. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
AISC Manual of Steel Construction	American Institute of Steel Construction, Manual of Steel Construction Allowable Stress Design-9th Edition
ASTM A36/A36M	Structural Steel
ASTM A48	Gray-Iron Castings
ASTM A283/A283M	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A307	Carbon Steel Externally Threaded Standard Fasteners
ASTM A320/A320M	Alloy-Steel Bolting Materials for Low Temperature Service
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

1.03 SUBMITTALS

A. Submittals shall be provided in accordance with Section 01330 and shall include the following information:

1. Certified test reports. Before delivery of any miscellaneous metalwork, the Contractor shall provide certificates which attest to their material compliance with these specifications.

2. Layout or installation shop drawings for all miscellaneous metals, including but not limited to, embedded and non-embedded steel metal work, stair treads, ladders, ladder rungs, flashing, pipe supports.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials for miscellaneous metalwork are specified in Table A.

Table A, Materials for Miscellaneous Metalwork	
Material	Specification
Nonstructural steel bars, angles, clips, and similar items	ASTM A36 or ASTM A283
Iron castings	ASTM A48
Structural steel tubing	ASTM A500, Grade B
Steel bolts (except flanges and anchor bolts)	ASTM A307, Grade A
Stainless steel	ASTM A320, type 304

B. General:

1. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.

2. Fabrication including cutting, drilling, punching, threading and tapping required for miscellaneous metal or adjacent work shall be performed prior to hot-dip galvanizing.

C. Seat Angles, Supports And Brackets:

1. Seat angles over slide gate guides shall be welded to the guides. Seat angles for grating, supports for floor plates, clips for precast panels and brackets for piping shall be steel, hot-dip galvanized after fabrication unless otherwise specified.

D. Other Miscellaneous Steel Metalwork:

1. Other miscellaneous steel metalwork including embedded and nonembedded steel metalwork, hangers and inserts shall be as specified on the drawings and shall be hot-dip galvanized after fabrication.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators.

2. Metalwork to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if specified, recesses or blockouts shall be formed in the concrete. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned. Embedments shall be as specified in Section 03300.

B. Seat Angles, Supports And Guides:

1. Seat angles for grating and supports for floor plates shall be set so that they are flush with (do not protrude from) the floor and also maintain the grating and floor plates flush with the floor.

3.02 CLEANING

A. After installation, damaged surfaces of shop primed metals shall be cleaned and touched up with the same material used for the shop coat.

END OF SECTION

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SECTION 06100

ROUGH CARPENTRY

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Rough carpentry

B. Related Sections: Section 01330: Submittals

1.02 REFERENCES

A. NFPA National Design Specifications for Wood Construction.

B. NFPA Span Tables for Joists and Rafters.

C. NFPA Working Stresses for Joists and Rafters.

D. NFPA Wood Structural Design Data.

E. PS 1, U.S. Commerce Dept. Product Standard, Construction and Industrial Plywood.

F. PS 20, U.S. Commerce Dept. Product Standard, American Softwood Lumber Standard.

G. PS 56, U.S. Commerce Dept. Product Standard, Structural Glued Laminated Timber.

H. RIS Standard Specifications for Grades of California Redwood Lumber.

I. APA 303: American Plywood Association Siding Face Grades.

J. AITC 109: Standard for Preservation Treatment for Structural Glued Laminated Timber.

K. AITC 110: Standard Appearance Grade for Structural Glued Laminated Timber.

1.03 SUBMITTALS

A. Shop Drawings – submit in accordance with Section 01330 – Submittals. Shop drawings shall include the following:

1. Framing connection details, fastener connections, and dimensions except when details are included on Drawings.

2. Wood Trusses:

a. Design criteria, span, depth, slope and spacing of all trusses.

b. Minimum bearing width required by lumber in truss.

c. Design dead, live and wind loads and any concentrated loads and their point of application.

d. Species, grade, size and dimension of all lumber.

e. Connection details and plating requirements.

f. Bracing details and location.

g. Letter of certification signed and stamped by licensed Professional Civil or Structural Engineer registered in State of California, stating that wood trusses have been designed to meet the requirements of the Drawings, Specifications and the 2006 International Building Code.

h. Test results of connector plate lateral load evaluation to determine normal load values for design based on ultimate load and proportional limit value at 0.015 inch.

i. Adjustments to metal connector plate and lumber design values.

B. Certification:

1. Pressure treated wood: Submit certification by treating plant stating chemicals and process used, net amount of salts retained, and conformance with applicable standards.

2. Preservative treated wood: Submit certification for water borne preservative that moisture content was reduced to 19 percent maximum, after treatment.

3. Fire-retardant treatment: Submit certification by treating plant that fire-retardant treatment materials comply with governing ordinances and that treatment will not bleed through finished surfaces.

1.04 QUALITY ASSURANCE

A. Certifications:

1. Lumber grading rules and wood species: PS 20 or RIS as appropriate.

2. Plywood grading rules: Softwood Plywood Construction and Industrial; PS 1

3. Grade marks:

a. Identify lumber and plywood by official grade mark.

b. Lumber:

1) Grade stamp to contain symbol of grading agency certified by Board of Review, American Lumber Standards Committee, mill number or name, grade of lumber, species or species grouping or combination designation, rules under which graded where applicable, and condition of seasoning at time of manufacture.

2) S Grn: Unseasoned

3) S Dry: Maximum 19 percent moisture content.

4) MC 15: Maximum of 15 percent moisture content.

5) Dense: Density classification applies to Douglas Fir and Southern Pine, when applicable.

c. Softwood plywood:

1) Conforming to PS 1.

4. Testing:

a. ASTM E84, maximum 25 flame spread rating.

5. Structural glued laminated timber:

a. Stamp: AITC

B. Regulatory Requirements:

1. Fire hazard classification: Underwriters' Laboratories, Inc., for treated lumber and plywood.

2. Preservative treated lumber and plywood: American Wood Preservers Bureau, Quality Mark.

3. Pressure treated material: American Wood Preservers Bureau Standards.

4. Span tables: National Forest Products Association.

5. Working stresses: Softwood Lumber, National Design Specification, National Forest Products Association.

6. Building code requirements.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Immediately upon delivery to job site, place materials in area protected from weather.

B. Store materials a minimum of 6 inches aboveground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation or ventilation.

C. Do NOT store seasoned materials in wet or damp portions of building.

D. Protect fire retardant materials against high humidity and moisture during storage and erection.

E. Protect sheet materials from breaking corners and damaging surfaces while unloading.

F. Trusses:

1. Handle with care and in accordance with manufacturer's instructions.

2. Stockpile or store in position acceptable to Owner Representative.

3. Protect from construction operations.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Lumber:

1. Dimensions:

a. Specified lumber dimensions are nominal.

b. Actual dimensions to conform to PS 20.

2. Surfacing: Surface 4 sides (S4S), unless specified otherwise.

3. Framing lumber:

a. Douglas Fir - Larch

b. Light framing:

1) General framing:

a) Standard and better or stud grade.

b) Provide for all framing, unless otherwise indicated on Drawings.

2) Plates, blocking, bracing, and nailers: Utility grade.

c. Studs:

1) Loadbearing: Stud, Standard, or No. 3 grade.

d. Structural light framing, 2 inches to 4 inches thick, 2 inches to 6 inches wide:

1) Grade: No. 2 or better.

2) Where indicated on Drawings.

e. Structural joists and planks, 2 inches to 4 inches thick, 6 inches and wider:

1) Grade: No. 2 or better.

2) Where indicated on Drawings.

f. Beams and stringers, posts and timbers, 5 inches and thicker:

1) Grade: No. 2 or better.

4. Redwood: Construction grade heartwood.

B. Plywood:

1. Per PS 1.

2. Exterior graded plywood where edge or surface is permanently exposed to weather.

C. Building Paper: Asphalt saturated felt, ASTM D226, 15-pound nonperforated.

D. Fire Retardant Treated Products

1. Lumber: AWPA C20

2. Plywood: AWPA C27

E. Preservative Treated Wood Products:

1. Water borne salt preservatives for painted, stained, or exposed natural wood product:

a. AWPB LP 2, aboveground application.

b. AWPB LP 22, ground contact application.

c. Lumber redried to maximum moisture content of 19 percent, stamped "DRY".

2. Oil borne preservatives for any construction:

a. AWPB P 3, aboveground application, light petroleum solvent.

b. AWPB LP 33, ground contact application, light petroleum solvent.

c. AWPB LP 4, aboveground application, volatile petroleum solvent for interior application and hardwoods to be painted.

d. AWPB LP 44, ground contact application, volatile petroleum solvent.

e. AWPB LP 7, aboveground application, heavy petroleum solvent penta solution for outdoor applications exposed to weather where painting is not required.

f. AWPB LP 77, ground contact application, heavy petroleum solvent penta solution.

3. Creosote and creosote preservatives for wood placed in ground or in water:

a. AWPB LP 5, aboveground application, creosote or creosote coal tar solutions.

b. AWPB LP 55, ground contact application, creosote or creosote coal tar solution.

4. Untreated lumber: Redwood, where indicated on Drawings.

F. Rough Hardware:

1. Bolts:

a. FS FF B 575

b. FS FF B 584

2. Nuts: FS FF N 836

3. Expansion shields: FS FF B 561

4. Lag screws and bolts: FS FF B 561

5. Toggle bolts: FS FF B 588

6. Wood screws: FS FF S 111

7. Nails and staples: FS FF N 105

8. Metal nailing discs:

a. Flat caps, minimum 1-inch diameter.

b. Minimum 30 ga sheet metal.

c. Formed to prevent dishing.

d. Bell or cup shapes NOT acceptable.

9. Joist hangers: 18 ga zinc coated steel.

10. Metal cross bridging: 16 ga zinc coated steel:

a. Nailable type with 2 holes in each end.

b. Compression type with prongs at each end.

11. Bar or strap anchors: ASTM A525, zinc coated steel, 18 ga minimum.

12. Ply clips: Extruded 6063 T6 aluminum alloy.

G. Truss Hardware:

1. Metal connector plates:

a. Galvanized sheet steel, ASTM A446, Grade A, coating Class G90 or G60.

b. Manufactured with holes, plugs, teeth, or prongs uniformly spaced and formed.

2. Bolts: FS FF-B-584

3. Nuts: FS FF-N-836

4. Lag screws, and bolts: FS FF-B-561

5. Nails: FS FF-N-105

6. Split rings: Tongue-and groove joint, hot-rolled carbon steel, ASTM A36

7. Shear plates: Malleable iron, Grade 35018, ASTM A47

8. Gussets: Carbon steel plate, ASTM A36

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces to receive rough carpentry materials are prepared to required grades and dimensions.

3.02 INSTALLATION

A. Sills: Pressure treated lumber or redwood.

1. Set level 1/16 inch, in 6 feet, in mortar bed, flush with exterior face of foundation.

2. Secure sills with 1/2 inch x 8 inches minimum size anchor bolts embedded in the structure minimum of 6 inches spaced maximum of 4-foot o.c.

3. Join solid sill members with halved joints, where not continuous and at corners, minimum of 1-foot lapped joint.

4. Lap built up sill members minimum distance of 2 feet.

5. Termite shields:

a. Bed termite shield in mortar bed and extend half/full distance across top of foundation wall, bend down 2 inches at angle of 45º on outside.

b. Fit around anchor bolts and fill joints with asphaltic mastic or solder.

B. Posts or Columns:

1. Provide 2 surfaces on posts at right angles to each other for installation of interior finish materials.

2. Built up posts: Arrange and nail together to accommodate type of construction.

3. Erect posts straight, plumb with straight edge, level, and brace with tack boards at plant and sill.

C. Joist Framing:

1. Install with crown edges up.

2. Support ends of each member minimum 1-1/2 inches of bearing on wood or metal.

3. Support ends of each member minimum 3 inches of bearing on masonry.

4. Support joists alternately at ends with solid blocking, 2 inches thick by depth of joists, between members crossing bearing points.

5. Lap members framing from opposite sides of beams, girders, or partitions, minimum 4 inches or tie opposing members together by toenailing or metal connectors.

6. Provide solid blocking between joists under door posts.

7. Notches:

   a. Do not notch in middle third of joists.

   b. Notches in top or bottom of joists: Maximum of 1/6 depth of member.

   c. Notched ends: Maximum of 1/3 depth of member.

8. Bored holes: Maximum 1/3 depth of member, 2 inches minimum distance to top or bottom of joists.

9. Bridging:

   a. Nominal depth to thickness ratio of joists exceeding 6, install bridging at 8-foot intervals.

   b. Solid bridging:

      1) Size: 2 inches x depth of joist x length of suit.

      2) Install offset to permit toenailing or end nailing.

      3) Space bridging maximum:

         a) Spans to 10 feet: 1 row midspan.

         b) Spans 10 feet to 20 feet: 2 rows at 1/3 span.

         c) Spans over 20 feet: Rows not over 8 feet apart.

D. Wood Trusses:

1. Use care when handling so as not to subject trusses to excessive lateral bending.

2. Erect trusses in accordance with recommendations of H1B 91 so as to be level, plumb and in correct location.

3. Cutting and altering trusses is not permitted.

4. Brace trusses sufficiently during construction to prevent toppling or dominoing prior to placing any load on trusses.

5. Connect trusses to remainder of structure using wood connectors in accordance with details on drawings and manufacturers' recommendations.

6. Provide bracing where required by truss designer.

E. Miscellaneous Framing:

1. Furring:

   a. 2 by 2 treated wood.

   b. Attach to concrete masonry wall with approved anchors as shown on Drawings.

2. Framing for mechanical work:

   a. Frame members for passage of pipes and ducts to avoid cutting structural members.

   b. Do not cut, notch, or bore framing members for passage of pipes or conduits without concurrence of Owner Representative.

   c. Reinforce framing members where damaged by cutting.

   d. Cutting or notching of wood trusses not allowed unless specifically noted on submitted and approved truss design.

END OF SECTION

SECTION 07215

BUILDING INSULATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section Includes:

1. Building insulation.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. American Society for Testing and Materials (ASTM):

a. C516, Standard Specification for Vermiculite Loose Fill Thermal Insulation.

b. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

c. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

B. Underwriters Laboratories Inc. (UL):

1. Building Materials Directory.

1.03 SUBMITTALS

A. Provide all submittal in accordance with Section 1330.

B. Shop Drawings:

1. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions.

c. Manufacturer's recommendations on sealants and mastics.

C. Miscellaneous Submittals:

1. Letter from insulation manufacturer stating that insulation proposed is acceptable for intended use per the Drawings.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contact Documents, the following manufacturers are acceptable:

1. Blanket or batt insulation (foil backed):

a. Owens-Corning Fiberglass Corp.

b. United States Gypsum Company (USG).

c. CertainTeed.

2.02 MATERIALS

A. Blanket or Batt Insulation:

1. Glass or other inorganic fibers and resinous binders formed into flexible blankets or semi-rigid sheets.

2. Thermal conductivity (k-value at 75°F): 0.27.

3. Foil faced vapor barrier laminated to one face with 1 IN flanges on long edges.

4. Flame spread: ASTM E84, not greater than 25.

5. Minimum thickness as noted on Drawings.

B. Vapor Barrier:

1. Minimum 1 mil thick aluminum foil between two layers of 1/2 MIL thick Mylar polyester.

2. Perm rating: Not exceeding 0.02.

3. Flame spread: ASTM E84, 25 maximum.

4. Similar to alumiseal "Zero-Perm Vapor Barrier."

C. Vapor Barrier Tape:

1. As recommended by vapor barrier manufacturer.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. General:

1. Insulate full thickness over surfaces to be insulated.

2. Fit tightly around obstructions, fill voids.

3. Cover all penetrations with insulation.

4. Seal all joints with sealant or tape as applicable.

5. Seal or tape to abutting materials to maintain vapor tightness.

6. Tape butted joints of Batt or blanket insulations.

7. Apply single layer to achieve total thickness.

8. Do not use broken or torn pieces of insulation.

9. Install so that completed installation is vapor tight.

10. If vapor barrier tape fails to adhere to any surface, apply sprayed-on adhesive as recommended by tape manufacturer to promote adhesion.

C. Blanket or Batt Insulation with or without Vapor Barrier:

1. Set with vapor barrier to warm side of building exterior wall. Do not obstruct ventilation spaces.
2. Fill all miscellaneous voids indicated on Drawings to be insulated.
3. Tape joints and ruptures in vapor barrier.
4. Use vapor barrier tape and seal each area of insulation to surrounding construction to assure vapor-tight installation.
5. At Contractor's option, provide blanket or Batt insulation without vapor barrier and provide separate vapor barrier as specified.

3.02 FIELD QUALITY CONTROL

A. Repair or replace damaged insulation as directed by Engineer.

END OF SECTION

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SECTION 07413

STANDING SEAM METAL ROOF

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the installation of batten seam copper roofing.

1.02 REFERENCED SECTIONS

A. Section 01330 – Submittals

B. Section 07600 – Flashing and Sheet Metal

1.03 INSTALLATION REQUIREMENTS

A. Install in accordance with SMACNA Architectural Sheet Metal Manual except as otherwise shown or specified.

1.04 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only:

B. American Society for Testing and Materials (ASTM):

1. A792/A792M-09: Standard Specifications for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

2. B32-08: Standard Specification for Solder Metal

3. C920-08: Standard Specifications for Elastomeric Joint Sealants

4. D226-06: Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Weatherproofing

5. D227-03: Standard Specification for Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing

6. D4397-09: Standard Specifications for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

7. E1514-98 (2003): Standard Specification for Structural Standing Seam Steel Roof Panel Systems

C. Federal Specification (Fed. Spec.):

1. UU-B-790A INT AMD:Building Paper, Vegetable Fiber: (Kraft, Waterproof, Water Repellent ad Fire Resistant)

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual 2003

1.05 SUBMITTALS

A. The Contractor shall submit information to substantiate compliance with this specification in accordance with Section 01330, Submittals.

PART 2 - PART 2 – PRODUCTS

2.01 METAL ROOF PANEL

A. Aluminum-Zinc Alloy Coated Sheet Steel

B. ASTM E1514

C. Factory formed metal roof panels designed to be field assembled by lapping and interconnecting raised side edges of adjacent panels with joint type indicated, and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for a weathertight installation.

D. Vertical rib, snap joint, standing seam metal roof panels: Formed with vertical ribs at panel edges and intermediate stiffening ribs symmetrically spaced between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels and snapping panels together.

E. Panel Coverage: // 304 mm (12 inches) // 406 mm (16 inches) // 608 mm (24 inches) //

2.02 SEALANTS

A. ASTM C920

B. Type, Grade, and Class as recommended in writing by the manufacturer.

2.03 SEALANT TYPE

A. Pressure sensitive, 100% solids, Gray Polyisobutylene compound with release-paper backing.

B. 12 mm (1/2 inch) wide x 3mm (1/8 inch) thick.

2.04 UNDERLAYMENT

A. Felts: ASTM D226, Type I or ASTM D227

B. Polyethylene sheet: 0.38 mm (15 mil) ASTM D4397

2.05 FASTENERS

A. A. Self-drilling, or self-tapping zinc plated hex head carbon-steel screws with neoprene washer or stainless steel cap.

B. B. ASTM B32: Flux type and alloy composition as required for use with metals to be soldered.

2.06 BUILDING PAPER

A. Fed. Spec. UU-B-790, Type I, Grade C.

2.07 FINISHES

A. Factory finished complying with SMACNA's recommendations for applying and designating finishes

B. Exterior Finish: Pluoropolymer

C. Color: As indicated

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal roof panel supports, and other conditions affecting performance of work.

1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.

B. Examine roughing-in for components and systems penetrating metal roof panels to verify actual locations of penetrations relative to seam locations of metal roof panels before metal roof panel installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of substances harmful to insulation, including removing projections capable of interfering with insulation attachment.

B. Install fascia and trim to comply with requirements specified in Section 07600, Flashing and Sheet Metal

C. Miscellaneous Framing: Install sub-purlins, eave angles, furring, and other miscellaneous roof panel support members and anchorage according to metal roof panel manufacturer's written recommendations.

1. Soffit Framing: Install furring channels to supports, as required to comply with requirements for assemblies indicated

3.03 INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal roof panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Field cutting of metal roof panels by torch is not permitted

2. Install panels perpendicular to purlins

3. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels

4. Provide metal closures at peaks, rake walls and each side of ridge and hip caps

5. Flash and seal metal roof panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws

6. Locate and space fastenings in uniform vertical and horizontal alignment

7. Install ridge and hip caps as metal roof panel work proceeds

8. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition

9. Lap metal flashing over metal roof panels to allow moisture to run over and off the material

B. Fasteners:

1. Steel Roof Panels: Use stainless-steel fasteners for surfaces exposed to the exterior and galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal roof panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal roof panel manufacturer.

1. Seal metal roof panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal roof panel manufacturer.

3.04 FIELD-ASSEMBLED METAL ROOF PANEL INSTALLATION

A. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.

1. Install clips to supports with self-tapping fasteners.

2. Install pressure plates at locations indicated in manufacturer's written installation instructions.

3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.

B. Metal Soffit Panels: Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.

1. Flash and seal panels with weather closures where metal soffit panels meet walls and at perimeter of all openings

C. Fascia Panels: Align bottom of panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings

3.05 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.

3.06 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal roof panel units within installed tolerance of 6 mm in 6 m (1/4 inch in 20 feet) on slope and location lines as indicated and within 3 mm (1/8 inch) offset of adjoining faces and of alignment of matching profiles.

3.07 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal roof panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal roof panel installation, clean finished surfaces as recommended by metal roof panel manufacturer. Maintain in a clean condition during construction.

B. Replace metal roof panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.08 INSTALLATION EXPERIENCE

A. Roofing shall be provided by a contractor regularly engaged in standing seam metal roofing installation for the last five years.

END OF SECTION

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SECTION 07600

FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section Includes:

1. Architectural flashing and sheet metal work.

1.02 REFERENCED SECTIONS

A. Section 01330 – Submittals

B. Section 01600 – Material and Equipment

1.03 QUALITY ASSURANCE

A. Referenced Standards:

1. The Aluminum Association (AA):

a. DAF-45, Designation System for Aluminum Finishes.

2. American Society for Testing and Materials (ASTM):

a. A653, Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanized) by the Hot-Dip Process.

b. B32, Specification for Solder Metal.

c. B209, Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

d. B308, Specification for Aluminum-Alloy 6061_T6 Standard Structural Profiles.

3. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

a. Architectural Sheet Metal Manual Fourth Edition, 1987.

b. Architectural Sheet Metal Specifications.

B. Qualifications:

1. Sheet metal fabricator shall have minimum 10 years' experience in fabrication of sheet metal items similar to items specified.

2. Sheet metal installer shall have minimum 5 years' experience installing sheet metal items specified.

1.04 DEFINITIONS

A. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.

1. Installer or applicator is synonymous.

1.05 SUBMITTALS

A. Shop Drawings:

1. See Section 01330

2. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Manufacturer's installation instructions

3. Fabrication and/or layout drawings

a. Scaled dimensioned drawing showing expansion joint locations, special conditions, profile, fastening and jointing details.

B. Samples:

1. Finish and color samples for each product specified for Engineer's selection

a. Colored pictures or color cards are not acceptable

C. Miscellaneous Submittals:

1. Fabricator qualifications

2. Installer qualifications

3. Warranty

1.06 WARRANTY

A. Furnish 5-year warranty on sheet metal work, signed jointly by Contractor and sheet metal installer

1. Agree to repair or replace work which leaks water or, where applicable, air or deteriorates excessively, including color failure, or otherwise fails to perform as watertight and, where appropriate, airtight flashing

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Reglets:

a. Fry Reglet Corp

b. Superior

c. Cheney

B. Submit request for substitutions in accordance with Specification Section 01600.

2.02 MATERIALS

A. Fasteners: Non-ferrous compatible with sheet metal

B. Retainer Clips and Continuous Cleats: Galvanized steel or stainless steel

C. Solder: ASTM B32.

D. Dissimilar Metal Protection: Provide materials with appropriate dielectric attachments that prevent corrosion due to dissimilar metals

E. Reglets: Non-ferrous, compatible with sheet metal

2.03 ACCESSORIES

A. Accessories as required to form a complete water and airtight system

2.04 FABRICATION

A. Retainer Clips and Continuous Cleats: 16 GA galvanized steel, G60 coating minimum

B. Reglets:

1. Profiles required for uses shown on Drawings

2. Use 24 GA galvanized steel with galvanized steel sheet metal

3. Provide interior and exterior factory fabricated corners at all corner locations

4. Use 0.020-in stainless steel with aluminum or stainless steel sheet metal

5. Fabricate as required to fit special conditions

6. Similar to Fry Reglet Corporation "Original Reglet" for use in masonry

C. Shop fabricate items to maximum extent possible.

1. Fabricate true and sharp to profiles and sizes indicated on Drawings

a. Shop fabricate and weld or solder all corners

PART 3 - EXECUTION

3.01 PREPARATION

A. Provide items to be built into other construction in time to allow their installation

B. If such items are not provided in time for installation, sheet metal fabricator cut in and install

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions, SMACNA, and as indicated on Drawings

B. Solder steel and weld aluminum to achieve weather tight joints and required details; do not solder or weld slip joints and prefinished items

C. Set top edges of membrane flashing and sheet metal flashing into reglets

D. Fasten materials at intervals recommended by SMACNA

E. Install slip joints to allow for thermal movement as recommended by SMACNA and manufacturer.

1. Maximum spacing: 10-ft OC

2. Provide slip joint 24-in from corners

3. Provide slip joint at each vertical expansion joint location in wall

   a. Provide break in continuous cleat at each vertical expansion joint

F. Caulk slip joints with two beads of sealant on each side of slip joint overlap.

G. Caulk all exposed joints of coping with sealant to match color of metal being sealed

H. Form flashings to provide spring action with exposed edges hemmed or folded to create tight junctures

I. Provide dissimilar metals and materials protection where dissimilar metals come in contact or where sheet metal contacts mortar, concrete masonry or concrete

J. Provide all components necessary to create watertight junctures between roofing and sheet metal work.

K. Provide all miscellaneous sheet metal items not specifically covered elsewhere, as indicated or required to provide a weather tight installation.

END OF SECTION

SECTION 07910

PERFORMED JOINT FILLERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies preformed joint fillers as required to complete the required work as shown on the Drawings and specified herein.

1.02 REFERENCED SECTIONS

A. Section 01330 – Submittals

B. Section 07920 – Sealants

1.03 QUALITY ASSURANCE

A. Reference – This section contains references to the following documents: They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ASTM D994	Preformed Expansion Joint Filler for Concrete (Bituminous Type)
ASTM D1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

PART 2 - PRODUCTS

2.01 PREFORMED ASPHALT FIBERBOARD

A. Preformed asphalt fiberboard joint filler shall be in accordance with ASTM D994 and shall be 112 inch thick unless otherwise specified.

2.02 PREFORMED RESIN-BONDED CORK

A. Preformed resin-bonded cork joint filler shall be in accordance with ASTM D 1752, Type II. Cork joint filler thickness shall match the specified joint width.

2.03 PRODUCT DATA

A. The Manufacturer's recommendations for the handling and installation of the material shall be provided in accordance with Section 01330.

PART 3 - EXECUTION

3.01 GENERAL

A. Preformed joint fillers shall be placed into position before the concrete is poured. Where it is necessary for the filler to be fixed to existing concrete or other building materials, a suitable adhesive recommended by the filler manufacturer shall be used. Filler surfaces shall be clean and dry prior to the placement of the concrete.

3.02 PREFORMED ASPHALT FIBERBOARD

A. Preformed asphalt fiberboard joint fillers shall be used for expansion joints in concrete sidewalks, curbs, and roadways.

3.03 PREFORMED RESIN-BONDED CORK

A. Preformed resin-bonded cork joint filler shall be used for expansion joints in concrete structures. The expansion joint shall be sealed with a backer rod and sealant as specified in Section 07920.

END OF SECTION

SECTION 07920

SEALANTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies sealants as required to complete the required work as shown on the Drawings and specified herein.

1.02 REFERENCES

A. This section contains references to the following documents:

Reference	Title
FEDSPEC TT -S-00230C	Sealing Compound: Elastomeric Type, Single Component
FEDSPEC IT-S-00227E	Sealing Compound: Elastomeric Type, Multi-Component

PART 2 - PRODUCTS

2.01 POLYURETHANE SEALANT

A. Acceptable Products – Acceptable products shall be Sikaflex by Sika Chemical Corporation, Vulkem by Mameco International, U-Seal Joint Sealant by Burke Company, or Rubber Calk by Products Research and Chemical Corporation.

B. General – Polyurethane sealants shall conform to FEDSPEC IT-S-0230C for one-component systems and FEDSPEC TT-S-00227E for two-component systems. Polyurethane sealant shall be one of the following two types:

1. Self-Leveling – Self-leveling polyurethane sealant shall be Type I, Class A as specified by the FEDSPECs referenced above.

2. Non-sag – Non-sag polyurethane sealant shall be Type II, Class A as specified by the FEDSPECs referenced above.

C. Primer – Primer shall be as recommended by the sealant manufacturer.

D. Backer Rod or Backer Tape – Backer rod shall be open cell polyethylene or polyurethane foam. Rod shall be cylindrical unless otherwise specified. Backer tape shall be polyethylene or polyurethane with adhesive on one side.

2.02 MASTIC SEALANT

A. General – Mastic joint sealant shall consist of a blend of refined asphalts, resins and plasticizing compounds, reinforced with fiber. Sealant shall be compatible with joint fillers and shall be pressure grade.

B. Primer – Primer shall be as recommended by the mastic sealant manufacturer.

2.03 PRODUCT DATA

The following information shall be provided in accordance with Section 01330:

A. Manufacturer's product data showing conformance to the specified products.

B. Manufacturer's recommendations for storage, handling and application of sealants and primers.

PART 3 - EXECUTION

3.01 GENERAL

A. Sealants and primers shall be applied according to the sealant manufacturer's recommendations. Polyurethane sealants shall be used on all expansion joints and specified construction joints.

B. Joints and spaces to be sealed shall be clean, dry and free of dust, loose mortar, concrete and plaster. Additional preparation of joints and spaces shall be provided in accordance with manufacturer's recommendations. Primer shall be applied only to the surfaces that will be covered by the sealant.

3.02 POLYURETHANE SEALANTS

A. General – Non-sag polyurethane sealants shall be used on vertical joints. Self-leveling polyurethane sealants shall be used on horizontal joints.

B. Joint Dimensions – Unless otherwise specified, joints and spaces to be filled shall be constructed to the following criteria. Joints and spaces shall have a minimum width of 114 inch and a maximum width of 1 inch. The depth of the sealant shall be one-half the width of the joint, but in no case less than 114 inch deep. Sealant depth shall be measured at the point of smallest cross section. When joints exceed the depth requirements, backing rod shall be inserted to provide the joint depth specified. If the joint sealant depth is within the specified tolerances, backer tape shall be placed in the bottom of the joint.

3.03 MASTIC SEALANT

A. Joint Dimensions – Joints to be sealed shall be 2 inches deep, 1 inch wide at the top, and 3/4 inch wide at the base.

END OF SECTION

SECTION 8100

STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies control building's electrical and storage rooms as well as the restroom's steel doors and frames.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents.

Reference	Title
ANSI 100	Recommended Specifications - Standard Steel Doors and Frames
ANSI A115.1	Preparation for Mortise Locks for 1-3/8 Inch and 1-3/4 Inch Doors
ANSI A115.4	Preparation for Lever Extension Flush Bolts
NFPA 80	Standard for Fire Doors and Other Opening Protectives
NFPA 252	Standard Methods of Fire Tests of Door Assemblies
SDI 105	Recommended Erection Instructions for Steel Frames.
SDI 107	Hardware on Steel Doors (Reinforcement-Application)
SDI 111-F	Recommended Completed Opening Anchors for Standard Steel Doors and Frames
UL 10B	Standard for Fire Tests of Door Assemblies

B. Certificates of Compliance:

1. Manufacturer's certificates shall be provided attesting that doors, frames, and accessories meet the specified requirements. The grade and model number of each door shall be included.

1.03 SUBMITTALS

A. Product Data

1. Submit product data in accordance with Section 01330.

2. Submit material list of items proposed to be provided under this section.

B. Shop Drawings

C. Shop drawings will be provided by the Contractor and include the following information:

1. Elevations of each door type

2. Size of doors and frames

3. Metal gages

4. Details of door and frame construction

5. Methods of anchorage

6. Louver details

7. Glazing details

8. Weather stripping

9. Provisions for and location of hardware

10. Details of installation

11. Schedule showing location of each door, frame, and swing of door

D. Submit detailed specifications and instructions for installation, adjustments, cleaning, and maintenance.

1.04 PRODUCT HANDLING

A. Doors, frames, and accessories shall be delivered undamaged and with protective wrappings or packaging. Doors and frames shall be stored on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4-inch airspace between doors. Damp or wet packaging shall be removed immediately and affected surfaces wiped dry. Damaged materials shall be replaced with new.

PART 2 - PRODUCTS

2.01 STEEL DOORS

A. General:

1. Steel doors shall be 1-3/4 inches thick and conform to ANSI 100 and used for the electrical room of the control building. Doors shall be either hollow steel construction or composite construction, and shall be prepared to receive hardware specified in Section 08710.

B. Hollow Steel Doors:

1. Unless otherwise specified, hollow steel doors and transom panels shall be fabricated from cold rolled steel and shall be extra heavy duty doors conforming to ANSI 100, Grade III, Model 3, of the sizes and designs specified. Face sheets, as well as lock and hinge edges, shall have a smooth, seamless and unbroken surface, with top and bottom edges closed flush to the door face sheets. No inverted channels will be allowed.

2. Inner structure shall be formed as a unitized grid composed of minimum 18-gage steel vertical and horizontal channels with rigidized webbing. The grid shall be unitized by double projection welding at each junction, and the applicable hardware reinforcements attached by multiple welds. The grid shall form the flush top and bottom sections of the door. Hinge and lock accommodations shall be pre-formed as an integral part of the continuous vertical member forming the periphery of the unitized grid. The back-up reinforcement of hinges and lock shall extend not less than 5 inches into the interior of the unitized grid and join the parallel inner vertical member of the grid structure. Inside surfaces of the face sheets shall be coated with a synthetic resin based sound deadener. The face sheets shall be attached to the grid assembly by double projection multiple series welds.

3. All doors and transom panels shall be insulated and shall have a full door thickness of polystyrene or polyurethane insulation to provide an overall door insulation value of R7.

2.02 STANDARD STEEL FRAMES

A. General:

1. Steel frames shall conform to ANSI 100, shall be of the sizes and shapes specified, an4 unless otherwise specified, shall be fully welded unit type frames. Steel frames shall be provided for doors, transoms and windows.

B. Welded Frames:

1. Frame faces shall be continuously welded at comer joints. Stops and rabbets shall be mechanically interlocked or continuously welded. All welds shall be ground smooth. Frames be mortised and reinforced with heavy gage reinforcements for hinges and lock strikes. Steel spreaders to ensure proper alignment of the frame shall be used and shall remain in place until adjacent wall construction is complete.

C. Anchors:

1. General: Steel anchors shall be provided to secure the frame to adjoining construction. Anchors shall be zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2. Wall Anchors: A minimum of three anchors shall be provided for each jamb. Anchors shall be located opposite top and bottom hinges and midway between.

a. Anchors for masonry work shall be corrugated or perforated steel straps or 3/16-inch diameter steel wire, adjustable or T -shaped.

b. Anchors for stud partitions shall be welded or otherwise securely fastened to backs of frames. Anchors shall be designed and fastened to wood studs with nails, to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding.

c. Frames shall be secured to previously placed concrete or masonry with expansion bolts in accordance with SDI Ill-F.

d. Anchors for solid plaster partitions shall be secured solidly to back of frames and tied into the lath. Adjustable top strut anchors shall be provided on each side of frame for fastening to structural members or ceiling construction above. Size and type of strut anchors shall be as recommended by the frame manufacturer.

3. Floor Anchors: Floor anchors drilled for 3/8-inch anchor bolts shall be provided at bottom of each jamb member. Where floor fill occurs, bottom of frames shall be terminated at the indicated finished floor levels and supported by adjustable extension clips resting on and anchored to the structural slabs.

2.03 WEATHERSTRIPPING

A. Weatherstripping shall be as required by door manufacturer.

2.04 HARDWARE PREPARATION

A. Doors and frames to receive finish hardware shall be reinforced, drilled, and tapped for hardware in accordance with the applicable requirements of SDI 107 and ANSI A115.1 and A115.4. Drilling and tapping for surface-applied hardware shall be done in the field, but additional reinforcing for surface-applied hardware shall be built into the door at the factory. Hardware shall be located in accordance with the requirements of ANSI 100, as applicable.

2.05 FINISHES

A. Hot-Dip Zinc Coated and Factory Primed Finished:

1. Doors and frames shall be fabricated from galvanized steel, ASTM A653, Coating Designation G60 or A60 (galvannealed). Damaged zinc-coated surfaces shall be repaired by the application of zinc dust paint conforming to DOD-P-21035. Zinc-coated surfaces shall be phosphate treated and factory primed as specified in ANSI 100.

2.06 FABRICATION AND WORKMANSHIP

A. Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Exposed welded and soldered joints shall be ground smooth. Door frame sections shall be designed for use with the wall construction specified. Corner joints shall be well formed and in true alignment. Fastenings shall be concealed where practicable. On wraparound frames for masonry partitions, a throat opening shall be provided 1/8-inch larger than the actual masonry thickness. Frames in exposed masonry walls or partitions shall be designed to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

2.07 PRODUCT DATA.

A. Certificates of compliance specified in paragraph 1.02 B shall be provided as product data in accordance with Section 01330.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Frames:

1. Frames shall be set in accordance with SDI 105, and plumbed, aligned, and braced securely until permanent anchors are set. Bottoms of frames shall be anchored with expansion bolts or powder-actuated fasteners. Wall anchors shall be built in or secured to adjoining construction. Where frames require ceiling struts or overhead bracing, frames shall be anchored to the struts or bracing. Frames shall be backfilled with mortar. When an additive is provided in the mortar, inside of frames shall be coated with corrosion-inhibiting bituminous material.

2. For frames to be installed in exterior walls and to be filled with mortar or grout, the stops shall be filled with strips of rigid insulation to keep the grout

out of the stops and to facilitate installation of stop-applied head and jamb seals.

B. Doors:

1. Doors shall be hung in accordance with clearances specified in ANSI 100. After erection and glazing, hardware shall be cleaned and adjusted.

3.02 PROTECTION

A. Doors and frames shall be protected from damage, and damaged doors and frames repaired prior to completion and acceptance of the project or replaced with new, as directed. Rusted frames shall be wire brushed until all rust is removed, cleaned thoroughly, and applied with an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.03 CLEANING

A. Upon completion, exposed surfaces of doors and frames shall be cleaned thoroughly. Mastic smears and other unsightly marks shall be removed.

END OF SECTION

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SECTION 08113

FRP DOORS AND FRAMES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the control building's chlorine and fluoride room fiberglass reinforced polyester (FRP) doors and frame.

1.02 QUALITY ASSURANCE

A. References:

1. This section contains references to the following documents.

Reference	Title
ASTM E84	Flame Spread Rating
ASTM D 256	Impact Strength
ASTM D 638	Tensile Strength
ASTM D 790	Flexural Strength
ASTM D 695	Compressive Strength
ASTM D 570	Water Absorption
AAMA 624-07	Paint Adhesion
UL 10B	Fire Tests of Door Assemblies
NFPA 252	Fire Rated Doors and Frames
IBC Chapter 26	Installation of Foam Plastic

B. Certificates of Compliance:

1. Manufacturer's certificates shall be provided attesting that doors, frames, and accessories meet the specified requirements and the FRP doors are manufactured by a press molding technology. The model number of each door shall be included.

C. Doors and frames shall be installed by a manufacturer-approved installer.

D. Manufacturer shall inspect and approve in writing all door and frame installation.

E. Warranty: Provide written limited guarantee for products related to this specification that include:

1. Doors are guaranteed for the life of the product against delaminating and failure due to chlorine gas corrosion.

2. FRP frame welded comers and chemically bonded hinge reinforcements are guaranteed for the life of the product against failure due to chlorine gas or fluoride corrosion.

1.03 SUBMITTALS

A. Product Data

1. Submit product data in accordance with Section 01330.

2. Submit material list of items proposed to be provided under this section.

3. Provide catalog cut of FRP door detailing internal construction and reinforcements, materials used and description of molding process.

B. Shop Drawings

1. Shop drawings will be provided by the Contractor and include the following information:

2. Schedules or drawings of FRP doors and frames (and associated hardware) showing identifying mark numbers, door and frame types, typical elevations, nominal sizes, handing, actual dimensions and clearances and required hardware preps and reinforcements.

3. Supporting reference drawings pertaining to frame mounting details, door louver installation, hardware locations, and factory hardware cutouts and reinforcements.

C. Submit detailed specifications and instructions for installation, adjustments, cleaning, and maintenance.

D. Provide a complete set of available finish colors from the manufacturer for selection. Color to match the color of the steel doors and be approved by Engineer.

1.04 PRODUCT HANDLING

A. Doors, frames, and accessories shall be delivered undamaged and with protective wrappings or packaging. Doors and frames shall be stored on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4-inch airspace between doors. Damp or wet packaging shall be removed immediately and affected surfaces wiped dry. Damaged materials shall be replaced with new.

B. Handling and storage of the doors and frames shall be in accordance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURER

A. Company specializing in the manufacture of FRP doors and frames with a minimum of five years documented experience. All doors and frames shall manufactured by Tiger Door LLC, or approved equal.

B. Doors shall be prepared to receive hardware specified in Section 08710.

2.02 FRP DOORS

A. Heavy Duty Non-Fire Rated FRP Doors

1. Design: FRP doors shall be of seamless press-molded construction, minimum of 1-1/2 inches thick. Laminated FRP face sheets shall be applied while wet and uncured to an internal door stile and rail sub frame/core

assembly and then press-molded under heat and pressure. The composite door panel must be integrally fused over its entire surface area, not just adhesive-bonded at perimeter stiles and rails. Doors shall remain under pressure during curing for flat, warp-free surfaces.

2. Stiles and Rails: A high-modulus pultruded FRP square or rectangular tube sub frame is to be provided within the door. Tubes are to be mitered and joined internally at the comers with solid polymer blocks to yield a one-piece unit that does not require any secondary external sealing. Provide a tubular mid rail across width of door at lock height, and additional horizontal rails where specific design conditions dictate. Doors shall incorporate molded-in FRP edge strips, chemically bonded to the sub frame stiles, for machining of hardware mortises so as not to cut otherwise compromise the integrity of the pultruded stiles, nor allow moisture to penetrate into the core of the door. All connections shall chemically welded. No mechanical fasteners will be allowed. The use or inclusion of gypsum or wood into stile and rail construction is not permitted.

3. Core: For maximum rigidity and compressive strength either a triangular shaped 3/8" cell phenolic resin impregnated kraft paper honeycomb or a plastic honeycomb with face scrim core shall be used. Molding pressure and resin gel time shall be sufficient to allow for penetration of resin into the cellular structure of the core to maximize shear and peel strengths at the skin/core interface and eliminate the possibility of delamination. The honeycomb is to be completely enclosed within the stile and rail sub frame. Use of foam or balsa wood is not permitted.

4. Internal Reinforcement: High-modulus pultruded tubular FRP, high density polymer compression blocks, or plastic compression blocking at all hardware locations, and corner locations. No wood blocking, ribs or fittings shall be used. A minimum of 900 pounds of pullout strength is required for each factory supplied hinge screw.

5. Faces: Door facings shall utilize a chemical resistant thermosetting polyester resin system with fiber reinforcing layers. Manufacturer shall furnish door faces that are flush construction having no seams or cracks.

6. Chopped strand mat layers shall be used to provide bond integrity between gelcoat, laminated facings and the internal door structure. Structural reinforcement shall be in the form of a knitted multi-layer material with layers of unidirectional glass fiber oriented in both the vertical and horizontal directions for high stiffness, impact resistance and resistance to warping.

7. Finish: The exposed FRP door faces must have an integrally molded 25/30 mils thick (wet) ultra-violet light stabilized marine grade NPG-isophthalic polyester gelcoat or an industrial urethane chemical coating color topcoat applied by the Manufacturer. Facings shall have a slightly textured semi-gloss finish to minimize the visual effects of wear and tear. Door face color shall be a custom color specified by the Engineer to match the control building’s steel doors. Gelcoat may not be sprayed onto the door face as a secondary coating.

8. Astragals: All pairs of doors shall be furnished with an astragal from door manufacturer made of same pultruded FRP material as door stile, rail and edge as required. Astragal shall be located on the meeting stile edge of each inactive leaf of double door pairs. Astragal shall be installed to cover meeting stile gap to effect seal and security.

2.03 FRP FRAMES

A. A. Non-fire Rated FRP Frames:

1. Design: FRP Door frames furnished under this specification shall utilize a high-modulus pultruded structural FRP shape. The frame section shall be standard double rabbeted 5-3/4" deep x 2" face, 3116" thick, with integral 5/8" doorstop with 1-15/16" soffits, to match typical hollow metal configurations.

2. Comer Joints: KD jambs and header shall be joined at comers via miter connections. Post and beam comers will not be acceptable. Exposed fasteners for miter connections will not be acceptable except for wrap wall applications. One piece frames shall be factory joined with miter connections, then chemically welded with FRP material and ground visibly smooth at frame face. Mechanical joints will not be accepted in lieu of welded frames.

3. Hardware Reinforcements: FRP reinforcing shall be chemically welded to door frame material at required locations. Minimum screw pullout strength of 1100 lbs. per #12 x l" sheet metal screw is required. Mechanically fastened reinforcements are not permitted.

4. Anchors:

a. BOLT-IN: Provide manufacturer's required number of 3/8" diameter x 4" long flat head stainless steel sleeve anchors for masonry openings, 3/8" diameter x 4" machine screw with nut and washers for structural steel openings, #14 x 4" stainless steel flat head sheet metal screws for wood or steel stud openings. Provide single bolt anchor at center of all header over four feet in nominal width. Stainless steel bolts shall be furnished by the factory.

b. Finish: Frames shall have a factory applied industrial urethane chemical coating color topcoat, to match the color and sheen of the doors. Gelcoat may not be sprayed onto the frame as a secondary coating.

2.04 MECHANICAL PROPERTIES AND TEST PERFORMANCE

A. Pultruded structural shapes for stiles; rails, frames, and astragals shall exhibit the following minimum longitudinal coupon properties (per ASTM):

1. Tensile strength (D638) 30,000 psi

2. Comprehensive strength (D695) 30,000 psi

3. Flexural strength (D790) 30,000 psi

4. Flexural modulus (D790) 1,600,000 psi

5. Shear strength (D2846) 4,500 psi

6. Impact, notched (D256) 25 ft.-lbs./in
7. Barcol hardness (D2853) 50
8. Fire Resistance (E-84) Class I

B. Core material shall exhibit the following minimum properties (per ASTM):

1. Core material must comply with the International Building Code (IBC) Chapter 26 requirements for use with a plastic skin.
2. Shear strength, longitudinal direction (C273) 68.2 psi
3. Shear strength, transverse direction (C273) 25.8 psi
4. Shear modulus, longitudinal direction (C273) 6940 psi
5. Shear modulus, transverse direction (C273) 1878 psi
6. Shear elongation, longitudinal direction (C393 short beam) 1.79%
7. Shear elongation, transverse direction (C393 short beam) 2.72%
8. Max facing stress, long. direction (C393 short beam) 735 psi
9. Max facing stress, transverse direction (C393 short beam) 289 psi
10. Max core shear stress, long. direction (C393 short beam) 63.8 psi
11. Max core shear stress, transverse direction (C393 short beam) 24.9 psi
12. Modulus of elasticity (EI) per 1" width, longitudinal direction (C393 short beam) 4.92E+04 psi
13. Modulus of elasticity (EI) per I" width, transverse direction (C393 short beam) 1.97E+04 psi
14. Max facing stress, longitudinal direction (C393 long beam) 9011 psi
15. Max facing stress, transverse direction (C393 long beam) 4727 psi
16. Max core shear stress, longitudinal direction (C393 long beam) 48.3 psi
17. Max core shear stress, transverse direction (C393 long beam) 23.5 psi
18. Modulus of elasticity (EI) per 111 width, longitudinal direction (C393 long beam 1.14E+05 psi
19. Modulus of elasticity (EI) per 111 width, transverse direction (C393 long beam) 7.23E+05 psi
20. Stiffness “D”, longitudinal direction (C393 long beam) 379,270 psi
21. Stiffness “D”, longitudinal direction (C393 long beam) 260,608 psi
22. Compressive strength (C365) 53 psi
23. Compressive modulus (C365) 2110 psi
24. Density (C271) 2.421b/ft3

C. Adhesive shall exhibit the following minimum coupon properties (per SAE)

1. Tensile Strength (D882-83A modified) minimum 2000 psi
2. 8 day 25° C at 100% humidity Cross Peel (SAE J1553) min 330 psi

3. 7 day immersion in seawater Cross Peel (SAE J1553) min 330 psi

4. 30 day immersion in saltwater Cross Peel (SAE J1553) min 330 psi

5. 72 hr. immersion in gasoline Cross Peel (SAE Jl553) min 330 psi

6. 72 hr. immersion in 20% H2SO4 Cross Peel (SAE J1553) min 300 psi

D. ANSI A250.4 1,000,000 cycle test 1.4' x 8' door (up to a full light) and frame successfully tested in excess of 1,000,000 cycles with no failure of any of the design features of the door or frame.

2.05 WEATHERSTRIPPING

A. Weatherstripping shall be as required by door manufacturer.

2.06 FASTENERS

A. All fasteners for all hardware shall be type 304 CRSS (18-8 series corrosion resistant stainless steel).

2.07 HARDWARE PREPARATION

A. Doors shall be factory mortised and drilled for mortise template butt hinges, with #12x2" long stainless steel screws pre-installed for hinge attachment. Install hardware as listed in Section 08710.

B. Frames shall be factory machined and drilled for all hardware requiring mortises, with #12xl" long stainless steel screws preinstalled for hinge attachment.

2.08 FABRICATION AND WORKMANSHIP

A. Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Door frame sections shall be designed for use with the wall construction specified. Corner joints shall be well formed and in true alignment. Fastenings shall be concealed where practicable. On wraparound frames for masonry partitions, a throat opening shall be provided 1/8-inch larger than the actual masonry thickness. Frames in exposed masonry walls or partitions shall be designed to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

2.09 PRODUCT DATA.

A. Certificates of compliance specified in paragraph 1.02 B shall be provided as product data in accordance with Section 01330.

PART 3 - EXECUTION

3.01 IDENTIFICATION

A. Factory mark all doors and frames using a chemical resistant plastic tag with identifying number, keyed to shop drawings, prior to shipment.

3.02 INSTALLATION

A. Frames:

1. Install in strict accordance with manufacturer's instructions. Set plumb and square, using shims for bolt-in of existing openings, or wood bracing prior to grouting of jambs. Use at least two 2x6 wood spreaders inside frame to maintain critical opening dimensions during grouting.

B. Doors:

1. Hang per manufacturer's instructions using screws provided for hinge attachment. Install doors to swing freely and to stand open at any angle. After installation make final adjustments to hardware to allow for proper door operation and latching. All surface applied hardware shall be thru bolted.

3.03 PROTECTION

A. Doors and frames shall be protected from damage, and damaged doors and frames repaired prior to completion and acceptance of the project or replaced with new, as directed.

3.04 CLEANING

A. Clean exposed surfaces of FRP doors and frames with a mild, non-abrasive cleaner and water.

B. Only chemical cleaning solution as recommended by the manufacturer shall be used.

END OF SECTION

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SECTION 08625

TUBULAR SKYLIGHT

PART 1 - GENERAL

1.01 DESCRIPTIONS

A. This section describes the tubular skylight (skylight) which consists of a roof dome, reflective tube, and diffuser assembly. The locations of the skylights are shown on the drawings.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2008a.
3. ASTM A 463/A 463M - Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process; 2006.
4. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized), by the Hot Dip Process; 2007.
5. ASTM E 283 - Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004.
6. ASTM E 308 - Standard Practice for Computing the Colors of Objects by Using the CIE System; 2006.
7. ASTM E 330 - Structural Performance of Exterior Windows, Curtain Walls and Doors; 2002.
8. ASTM E 547 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors and Curtain walls by Cyclic Air Pressure Difference; 2000.
9. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
10. ASTM E 1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Windborne Debris in Hurricane.
11. ASTM D 635 - Test Method for Rate of Burning and/or Extent of Time of Burning of Self-Supporting Plastics in a Horizontal Position; 2006.
12. ASTM D-1929 - Test Method for Ignition Properties of Plastics; 1996 (2001).
13. UL 181 - Factory Made Air Ducts and Air Connectors
14. ICC AC-16 - Acceptance Criteria for Plastic Skylights; 2008.

15. Completed skylight assemblies shall be capable of meeting the following performance requirements:

a. Air Infiltration Test: Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.

b. Water Resistance Test: No uncontrolled water leakage at 10.5 psf pressure differential with water rate of 5 gallons/hour/sf when tested in accordance with ASTM E 547.

c. Uniform Load Test:

1) No breakage, permanent damage to fasteners, hardware parts, or damage to make system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf (7.18 kPa) or Negative Load of 60 psf (2.87 kPa) in accordance with ICC AC-16 Section A, or Negative Load of 70 psf (3.35 kPA) if tested per ICC AC-16 Section B.

2) All units shall be tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.

d. Fire Testing:

1) When used with the Dome Edge Protection Band, all domes meet fire rating requirements as described in the 2006 International Building Code.

2) Self-Ignition Temperature - Greater than 650 degrees F per ASTM D-1929.

3) Smoke Density - Rating no greater than 450 per ASTM Standard E 84 in way intended for use. Classification C.

4) Rate of Burn and/or Extent - Maximum Burning Rate: 2.5 inches/min (62 mm/min) Classification CC-2 per ASTM D 635.

5) Rate of Burn and/or Extent - Maximum Burn Extent: 1 inch (25 mm) Classification CC-1 per ASTM D 635.

1.03 DEFINITIONS

A. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.

1.04 SUBMITTALS

A. Shop Drawings:

1. See Section 01330.

2. Fabrication and/or layout drawings:

a. Submit shop drawings for all fabrications and assemblies including anchorage flashings, and accessories.

3. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.

b. Preparation instructions and recommendations.

c. Manufacturer's installation instructions.

d. Storage and handling requirements and recommendations.

4. Verification Samples: As requested by Engineer.

5. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.

6. Manufacturer’s Qualifications: Engaged in the manufacture of tubular skylights for a minimum of 15 years.

1.05 WARRANTY

A. Skylight: Manufacturer’s standard warranty for 10 years.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Solatube International, Inc.,

B. Or an approved equivalent

2.02 MATERIALS

A. Skylight General : Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.

B. Brighten Up Series: Solatube Model 160 DS, 10 Inch (250 mm) Skylight System.

1. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.

a. Outer Dome Glazing: Type DA, 0.125 inch (3 mm) minimum thickness injection molded acrylic classified as CC2 material; UV inhibiting (100 percent UV C, 100 percent UV B and 98.5 percent UV C), impact modified acrylic blend.

b. Raybender 3000: Variable prism optic molded into outer dome to capture low angle sunlight and limit high angle sunlight.

c. LightTracker Reflector: Aluminum sheet, thickness 0.015 inch (0.4 mm) with Spectralight Infinity. Positioned in dome to capture low angle sunlight.

2. Flashing Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.

3. Tube Ring: Attached to top of base section; 0.090 inch (2.3 mm) nominal thickness injection molded high impact acrylic; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing.

4. Reflective 30 degree Adjustable tube: Aluminum sheet, thickness .015 inch (0.4 mm)

a. Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface. Visible spectrum (400 nm to 760 nm) greater than 99 percent. Total solar spectrum (400 nm to 2500 nm) less than 80.2 percent

5. Ceiling Ring: Injection molded, impact resistant acrylic. Nominal thickness is 0.110 inches.

6. Dual Glazed Diffuser Assembly:

a. Upper glazing: PET GAG plastic with EPDM low density sponge seal to minimize condensation and bug, dirt, and air infiltration per ASTM E283. The nominal thickness is 0.039 inches (0.99 mm).

1) Natural Effect Lens: Type LN

2.03 ACCESSORIES

A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon

B. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.

C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

PART 3 - EXECUTION

3.01 PREPARATION

A. Prior to installation, inspect and verify condition of substrate. Installation of product constitutes installer's acceptance of substrate condition for product compatibility.

B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.

C. Field welding aluminum is not permitted unless approved in writing by Engineer.

D. Clean surface thoroughly prior to installation.

E. Prepare surfaces using methods recommended by the manufacturer for achieving the best result for the substrate under project conditions.

3.02 INSTALLATION

A. Install in accordance with the manufacturer's printed instructions.

B. After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Engineer. Correct if needed before proceeding with installation of subsequent units.

3.03 PROTECTION

A. Protect installed products until completion of the project.

B. Touch-up, repair, or replace damaged products before Substantial Completion

END OF SECTION

SECTION 08710

FINISHED HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies finish hardware, including trim, attachments, and fastenings specified or required for proper and complete installation.

1.02 SUBMITTALS

A. Product Data

1. Submit product data in accordance with Section 01330.

2. Submit materials list of items proposed to be provided under this section.

B. Hardware List:

1. The Contractor shall submit a hardware list, identifying each hardware item by manufacturer, manufacturer's catalog number, catalog cuts, and exact location in the work. The hardware list shall be in suitable form to facilitate ready checking and approval by the Engineer. Approval of the hardware schedule does not relieve the hardware supplier from the responsibility of furnishing the job complete.

1.03 PRODUCT HANDLING

A. Individually packaged each unit of finish hardware, complete with proper fastenings and appurtenances, clearly marked on the outside to indicate contents and specific locations in work.

PART 2 - PRODUCT

2.01 GENERAL

A. Door Locks

1. Furnish “Schlage” lever lock handle set equipped with a cylinder that will fit a type “3” keyway with 6 pins to match the City keying system. Lock shall have a corrosion resistant finish suitable for marine applications. Lock shall have “storeroom function” defined as requiring a key for each outside entry and using a “Panic Bar” to allowing exit the rooms without a key.

2. Locks are not required for interior doors.

B. Latch Guards

1. Furnish heavy duty exterior door latch guard construction of stainless steel, 3 inch wide and 11 inches tall to protect latch

C. Fasteners

1. Furnish necessary screws, bolts, and other fasteners of suitable size and type to anchor the hardware in position for long life under hard use.

2. Where necessary, furnish fasteners with toggle bolts, expansion shields, hex bolts, and other anchors approved by the Engineer, according to the material to which the hardware is to be applied and according to the recommendations of the hardware manufacturer.

3. Provide fasteners which match with the hardware as to finish and material.

4. All screws shall be full thread, and shall have “Phillips” heads.

D. Flush Bolts

1. Furnish and install flush bolts at the top and bottom of the door opposite the door lock.

2. Flush bolts shall be specifically designed for use with metal doors.

3. Contractor shall make provisions at the top and bottom of the door frames for proper latching of the bolts.

4. Bolts shall be dark bronze and fully automatic.

E. Where butts are required to swing 180 degrees, furnish butts of sufficient throw to clear the trim. Butts on reverse bevel doors with locksets shall be non-removable pin (NRP).

F. Furnish silencers for door frames at the rate of three for each single door and two for each door or pair of doors; except doors with weather-strip, light seals, or sound seals.

G. Furnish thresholds and door bottoms as specified or as detailed.

2.02 KEYING

A. Key locks and cylinders as directed by the Engineer. Dead bolt and padlocks shall be keyed to meet the City’s standard keys.

B. Furnish four construction keys for each lock, for Engineer’s inspection access and for operational access, and any additional quantity required by the Contractor.

C. Construction Keying

1. Furnish a construction key system with construction keys for locks and cylinders.

2. Use only the construction keys during construction.

D. Upon acceptance of the reservoir and pump station by the Owner, the Contractor shall utilize the services of a locksmith to field re-key locks to match Owner supplied standard keys for facility padlocks and deadbolts. Once the re-keying is completed, all standard keys will be returned to the Owner. This locksmith shall not provide copies of the standard keys to the Contractor.

2.03 DOOR STOPS AND HOOKS

A. The Contractor shall use an aluminum heavy duty wall mounted door stop with hook and holder by CRL or an approved equivalent for each of the doors.

2.04 DOOR CLOSERS

A. A Sargent 351 Series aluminum door closer or an approved equivalent shall be used for the electrical room doors.

B. A heavy duty corrosion resistant door closer shall be used for the chlorine room and fluoride rooms, which are corrosive environments. The Contractor shall submit a suitable door closer for use in these rooms to the Engineer for approval.

2.05 DOOR BUTTS

A. Hinges shall be full mortise, template type, unless half mortise hinges are required. Hinges shall have non-rising loose pins, ball or oil tight bearings and flat button tips, except when otherwise specified.

B. Where necessary to keep door leaf clear of walls, casings, jambs, or reveals in door openings, wide throw hinges of an approved type shall be furnished. For out swinging doors, hinges shall have a screw in the barrel to prevent removal of pin when door is closed.

2.06 TEMPLATES

A. In order to insure proper placement and fit, all hardware for metal doors or metal frames shall be made and installed with a template. Templates or physical hardware items shall be furnished to manufacturers concerned and shall be supplied sufficiently in advance to avoid delay in the work.

2.07 TOOLS AND MANUALS

A. Deliver to the Engineer one complete set of adjustment tools and one set of maintenance manuals for locksets, latch sets and closers.

2.08 CORROSIVE ENVIRONMENT HARDWARE

A. All finish hardware located inside the chlorine and fluoride rooms shall be resistant to chlorine and fluoride corrosion and be made out of aluminum, stainless steel or PVC.

2.09 SCHEDULE OF HARDWARE

A. Single source for items.

1. Except as specifically otherwise approved in advance by the Engineer, furnish for each item only the product of a single manufacturer.

2. To the maximum extent practicable, furnish similar items as the product of a single manufacturer.

B. For each of the required items of finish hardware, provide from the specified manufacturer or and approved equivalent:

Item	Manufacturer
Butts	PBB or Stanley
Locks	Schlage
Key Lock Box	Mortise
Thresholds	Reese
Seals	Reese
Door Latch Guard	Latch
Flush Bolts	Trimco

C. All Schlage locksets shall have a type “C” keyway and will be lockable with “storeroom” function.

D. Weather stripping: Pemko, NGP, or and approved equal. Stripping to be surface mounted at head and jamb.

E. Exit Device: All doors will be equipped with a panic bar.

PART 3 - EXECUTION

3.01 COORDINATION

A. Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

B. Upon completion of the work, as a condition of its acceptance, provide the inspection, adjustment, and report described in Paragraph 1.02 above.

3.02 INSPECTION AND ADJUSTMENT

A. The Contractor shall be responsible for proper installation and adjustment of all hardware items. Installation of hardware shall be checked by the Engineer after completion by the Contractor. Any items that do not fit properly, close, or otherwise perform in the manner intended or specified, shall be corrected prior to acceptance.

END OF SECTION

SECTION 09251

GYPSUM DRYWALL CONSTRUCTION

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the gypsum board and its associated accessories.

B. This Section does not apply to the following primary structures:

1. Control Building - See structural drawings
2. Concrete Tank – See Section 03370

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM C 473 – Standard Test Methods for Physical Testing of Gypsum Panel Products.
2. ASTM C 475 – Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
3. ASTM C 514 – Standard Specification for Nails for the Application of Gypsum Board.
4. ASTM C 645 – Standard Specification for Nonstructural Steel Framing Members.
5. ASTM C 754 – Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
6. ASTM C 840 – Standard Specification for Application and Finishing of Gypsum Board.
7. ASTM C 919 – Standard Practice for Use of Sealants in Acoustical Applications.
8. ASTM C 954 – Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs.
9. ASTM C 1002 – Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
10. ASTM C 1047 – Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
11. ASTM C 1280 – Standard Specification for Application of Gypsum Sheathing
12. ASTM C 1396 – Standard Specification for Gypsum Board

B. Gypsum Association (GA):

1. GA-214 – Recommended Levels of Gypsum Board Finish.
2. GA-216 – Application and Finishing of Gypsum Panel Products.
3. GA-253 – Application of Gypsum Sheathing.
4. GA-290 – Area Separation Walls.
5. GA-600 – Fire Resistance Design Manual.

1.03 SUBMITTALS

A. Submit in accordance with Section 01330.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Gypsum board, joint tape and finish
2. Preparation instructions and recommendations
3. Storage and handling requirements and recommendations
4. Installation methods

1.04 QUALITY ASSURANCE

A. Contractor shall have a minimum of 5 years' experience specializing in the installation of drywall.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other damaging causes.

1. Neatly stack gypsum boards flat to prevent sagging.
2. Handle gypsum boards to prevent damage to edges, ends, and surfaces.
3. Protect adhesives and joint compounds from freezing or overheating per manufacturer's instructions.

B. Store and dispose of solvent-based materials and supplies used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 PROJECT CONDITIONS

A. Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840 and GA-216.

B. Minimum Room Temperatures:

1. For non-adhesive attachment of gypsum board to framing, maintain not less than 40 degrees F (4.5 degrees C).
2. For adhesive attachment of gypsum board maintain not less than 50 degrees F (10 degrees C) for 48 hours prior to application and continuously thereafter until drying is complete.

C. Ventilate building spaces to remove moisture not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Drywall

1. Georgia-Pacific DensArmor Plus or an approved equivalent
2. Gypsum products complying with ASTM C 1396.
3. Board sized for use to minimize joints
4. Gypsum Ceiling Board: Regular Span24 Gypsum Board with ½-inch thickness

B. Accessories

1. Metal Corner Beads: ASTM C1047; formed galvanized steel angle, minimum base steel 0.014 inch thick, sizes as required to suit substrate.
2. Metal Casing Beads: ASTM C1047; formed galvanized steel trim, minimum base steel 0.014 inch thick, sizes as required to suit substrate.
3. Metal Control Joints: ASTM C1047; roll-formed zinc control joints with perforations in flanges; center channel with removable tape strip over channel.
4. Fastening Devices for Metal Framing: ASTM C1002.
5. Fastening Devices for Wood Framing: ASTM C514.
6. Steel Drill Screws: ASTM C 954.
7. Joint Compound and Tape: ASTM C 475.

C. Spray Texture Finish

1. Non-aggregated, non-asbestos powder producing light to medium-light textures on drywall or other interior surfaces.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which Work of this Section will be performed. Correct conditions detrimental to timely and proper completion of Work. Do not proceed until unsatisfactory conditions are corrected.

B. Examine substrates to which gypsum board construction attaches or abuts. Verify pre-set hollow metal frames, cast-in anchors, and structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of gypsum board construction.

3.02 PREPARATION

A. Ceiling Anchorage: Coordinate installation of ceiling suspension with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

3.03 INSTALLATION

A. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement to comply with details indicated on Drawings.

B. Where edges of suspended ceilings abut building structure horizontally at ceiling perimeters or penetrations of structural elements.

3.04 JOINT TREATMENT

A. General:

1. Inspect areas to be joint treated, verifying that the gypsum board fits snugly against supporting framework.

2. In areas where joint treatment and compound finishing will be performed, maintain a temperature of not less than 55 degrees F (13 degrees C) for 24 hours prior to commencing the treatment, and until joint and finishing compounds have dried.

3. Apply the joint treatment and finishing compound by machine or hand tool.

4. Provide a minimum drying time of 24 hours between coats, with additional drying time in poorly ventilated areas.

B. Embedding Compounds:

1. Apply to gypsum board joints and fastener heads in a thin uniform layer.

2. Spread the compound not less than 3 inches (76 mm) wide at joints, center the reinforcing tape in the joint, and embed the tape in the compound. Then, spread a thin layer of compound over the tape.

3. After this treatment has dried, apply a second coat of embedding compound to joints and fastener heads, spreading in a thin uniform coat to not less than 6 inches (152 mm) wide at joints. Feather edges.

4. Sand between coats.

5. When thoroughly dry, sandpaper to eliminate ridges and high points.

C. Finishing Compounds:

1. After embedding compound is thoroughly dry and has been completely sanded, apply a coat of finishing compound to joints and fastener heads.

2. Feather the finishing compound to not less than 12 inches (305 mm) wide.

3. When thoroughly dry, sandpaper to obtain a uniform smooth surface, taking care to not scuff the paper surface of the board

3.05 FINISH AND PAINTING

A. Level of finish and painting of the drywall ceiling shall be per Section 09910, Paragraph 3.09.

3.06 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch (1.5 mm) in 10 feet (3048 mm) in any direction.

3.07 PROTECTION

A. Provide final protection and maintain conditions that ensure gypsum board construction being without damage or deterioration at time of Substantial Completion.

3.08 CLEANING

A. At completion of each segment of installation in a room or space, promptly pick up and remove scraps, debris, and surplus materials of this Section from working area.

B. In addition to other requirements for cleaning, use necessary care to prevent scattering gypsum board scraps and dust, and to prevent tracking gypsum and joint finishing compound onto floor surfaces.

END OF SECTION

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SECTION 09900

COATING SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnishing all labor, equipment and material necessary to perform surface preparation and to furnish and apply all paint, protective coatings and finishes as specified herein and/or as indicated on the Drawings.

1.02 QUALITY ASSURANCE

A. General: Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and acceptable professional standards and are approved by the Engineer.

B. All materials furnished and all work accomplished under the Contract shall be subject to inspection by the Engineer. The Contractor shall be held strictly to the true intent of the Specifications in regard to quality of materials, workmanship, and diligent execution of the Contract.

C. Work accomplished in the absence of prescribed inspection may be required to be removed and replaced under the proper inspection, and the entire cost of removal and replacement, including the cost of all materials which may be furnished by the City and used in the work thus removed, shall be borne by the Contractor, regardless of whether the work removed is found to be defective or not. Work covered up without the authority of the Engineer, shall, upon order of the Engineer, be uncovered to the extent required, and the Contractor shall similarly bear the entire cost of accomplishing all the work and furnishing all the materials necessary for the removal of the covering and its subsequent replacement, as directed and approved by the Engineer.

D. Reference Publications

1. This section references the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
SSPC	Society of Protective Coatings

E. Warranty

1. The City will conduct warranty inspection within eleven months following completion and acceptance of all coating work. The City shall establish a date for the inspection and notify the Contractor five (5) days in advance. Any work found to be defective shall be repaired in accordance with the manufacturer's recommendations, this specification and to the satisfaction of the Engineer.

F. Coating Contractor

1. The Coating Contractor shall hold a current painting license and have a minimum five years practical experience in the application of specified products to surfaces at similar facilities.

1.03 SUBMITTALS

A. Submit the following specific information:

B. Manufacturer's product data sheets.

C. Complete data on each type of paint and primer. This shall be done whether or not the product is named herein.

D. Manufacturer's published application instructions.

E. Color chart for each paint for color selection by City.

1.04 DELIVERY AND STORAGE

A. All materials shall be delivered to the site in the manufacturer's sealed containers. Each container shall be labeled by the manufacturer, and the label shall be intact upon delivery. Labels shall give the manufacturer's name, brand, type of paint, batch number, color of paint, date of manufacture, storage life and instructions for reducing. Job mixing or job tinting may be done when approved by the Engineer and for sample colors.

B. The Contractor shall store all paint materials and equipment in a storage place protected from weather and excessive heat and cold. Necessary precautions shall be taken to reduce hazards to a minimum. Materials exceeding the storage life recommended by the manufacturer shall be removed from the site.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All paint and coating materials furnished for each coating system shall be the products of a single manufacturer. Only compatible materials shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats.

B. All adhesives, sealants and caulks shall be compliant with VOC and other toxic compounds limits & prohibitions. Adhesives, adhesive bonding primers, adhesive primers and caulks shall comply with Air Quality Management District rules, or limits as required by CAL Green.

2.02 COLORS

A. All colors and shades of colors of all coats of paint shall be as indicated or selected by the City. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by the City.

PART 3 - EXECUTION

3.01 COATINGS

A. Coating Systems

1. Shop Applied Prime Coat: Except as otherwise specified, prime coats shall be shop applied. Shop applied primer shall be compatible with the specific coating system and shall be applied at the minimum dry film thickness recommended by the manufacturer. Approved submittal data identifying the shop primer used shall be provided to the onsite finish coat applicator and to the Engineer before delivery of items to the jobsite. Damaged, deteriorated and poorly applied shop coatings that do not meet the requirements of this section, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.

2. Field Coats: Field coats shall consist of one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until the prime and intermediate coats have been inspected.

3.02 PREPARATION

A. General

1. All surfaces to be coated or painted shall be in the proper condition to receive the material specified before any coating or painting is performed. No more sandblasting or surface preparation than can be coated or painted in a normal working day will be permitted. All sharp edges, burrs and weld spatter shall be removed. The following levels of surface preparation are subsequently referred to:

   a. White Metal Blast Cleaning (SSPC-SP-5): Removal of all visible rust, mill scale, paint, and foreign matter by blast cleaning by wheel or nozzle (dry) using sand, grit, or shot.

   b. Near-White Blast Cleaning (SSPC-SP-10): Blast cleaning nearly to white metal cleanliness until at least 95 percent of each element of surface area is free of all visible residues.

   c. Commercial Blast (SSPC-SP-6): Blast cleaning until at least 67 percent of each element of surface area is free of all visible residues.

   d. Brush-Off Blast Cleaning (SSPC-SP-7): Blast cleaning of film, rust, loose coatings, and providing a roughened surface for application of a new finish coat.

   e. Solvent Cleaning (SSPC-SP-1): Removal of all grease, oil and dirt.

2. Clean cloths and clean fluids shall be used in solvent cleaning. Cleaning and painting shall be scheduled so that dust and spray from the cleaning process will not fall on wet, newly painted surfaces. Hardware, electrical fixtures and similar accessories shall be removed or masked during preparation and paint operations, or shall otherwise be satisfactorily protected. Equipment adjacent to walls shall be disconnected and moved to permit cleaning and painting of equipment and walls and, following painting, shall be replaced and reconnected.

B. Metallic Surfaces

1. Metallic surfaces shall be prepared in accordance with applicable portions of surface preparation specifications of the Steel Structures Painting Council (SSPC) specified in each coating system. The solvent in solvent cleaning operations shall be as recommended by the manufacturer.

C. Detailed Surface Preparation

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each coating system.

D. Existing Coating Systems

1. Unless otherwise specified, existing or shop applied coating systems damaged by new construction shall be repaired and coated in accordance with the appropriate system specified for new work.

2. Contractor shall demonstrate that the existing coating is compatible with field coating by applying small test patches of specific paints over existing coatings. If the existing coating is not compatible with the field coat (it lifts or ripples), the existing coating shall be reprimed with a primer compatible with both the existing coating and the field applied paint, or replaced with the proper prime coat. The primer shall be as recommended by the manufacturer of the field applied paints.

E. Inaccessible

1. Prior to erection of tank, all steel surfaces made inaccessible after erection shall be cleaned as specified herein and shall receive the coating/paint system for the specific area. This includes, but is not limited to, metal to metal contact areas, e.g. inaccessible areas, e.g. interior of overflow pipe and drain pipe.

3.03 APPLICATION

A. Workmanship

1. Each coat of paint shall be of the consistency as supplied by the manufacturer, or thinned if necessary, and applied in accordance with the manufacturer's written instructions. Each coat shall be well brushed, rolled, or sprayed to obtain a uniform and evenly applied finish. Work shall be free from "runs", "bridges", "shiners", or other imperfections due to faulty intervals. Particular care shall be taken to obtain a uniform, unbroken coating over all bolts, threads, nuts, welds, edges and corners. Further, all weld splatter shall be removed and all welds neutralized with thinner.

B. Environmental Conditions

1. Paints shall be applied only to surfaces that are dry, and only under such atmospheric conditions as will cause evaporation rather than condensation.

2. Paint shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation.

3. During damp weather, when the temperature of the surface to be coated is within 10°F of the dew point, the surfaces shall be heated to prevent moisture condensation thereon.

4. Bare metal surfaces, except those which may be warped by heat, may be dehydrated by flame-heating devices immediately prior to paint application.

5. During painting, and for a period of at least 8 hours after the paint has been applied, the temperature of the surfaces to be painted, the painted surfaces, and the atmosphere in contact shall be maintained at or above 50°F and not less than 10°F above the dew point.

6. Fans or heaters shall be used inside enclosed areas where conditions causing condensation are severe.

7. Paint shall not be applied on surfaces hotter than 120°F.

C. Protection of Coated Surfaces

1. Items which have been coated shall not be handled, worked on, or otherwise disturbed, until the paint is completely dry and hard. After delivery at the site of permanent erection or installation, shop coated metalwork shall be repainted or retouched with specified paint when it is necessary to maintain the integrity of the film.

D. Method of Paint Application

1. Only good, clean brushes and equipment shall be used; and all brushes, buckets, and spraying equipment shall be cleaned immediately at the end of each painting period.

2. If paint is applied by spray, the air pressure used shall be within the ranges recommended by both the paint and spray equipment manufacturers. Spray painting shall be conducted under controlled conditions, and the Contractor shall be fully responsible for any damage occurring from spray painting.

3. Care shall be exercised not to damage adjacent work during sandblasting operations. Stainless steel need not be sandblasted. Blasted surfaces shall be coated within 4 hours of being sandblasted. All dust shall be removed from the surfaces prior to painting.

E. Film Thickness and Continuity

1. The surface area covered per gallon of paint for various types of surfaces shall not exceed those recommended by the manufacturer.

2. The first coat (prime coat) on metal surfaces refers to the first full paint coat and not to conditioning, tie coats, sealers or other pretreatment applications.

3. Coatings shall be applied to the thickness specified, and in accordance with these specifications.

4. Unless otherwise specified, the average total thickness (dry) of any completed protective coating system on exposed metal surfaces shall be not less than 1.25 mils per coat, and the minimum thickness at any point shall not deviate more than 25 percent from the required average.

5. Unless otherwise specified, no less than two coats shall be applied.

F. Special Requirements

1. Hangers and supports shall be coated, except for the final coat, prior to the installation.

2. Except for those to be filled with grout, the underside of ungalvanized equipment bases and supports shall be coated with at least two coats of primer specified for system No. 5 prior to setting the equipment in place.

3. Bolts and bolt holes in flanges (such as those used with couplings or wafer type valves where holes and bolts as finally installed will be exposed to weather or moisture) shall be coated prior to assembly to prevent rusting of the unprotected metals.

G. Cleanup

1. Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any overspray or other paint related damage.

3.04 SPARE SUPPLIES

1. Provide one unbroken gallon container of each color and type of paint and each type of solvent and thinner required by the specifications.

3.05 COATING SYSTEMS

A. The coating systems used for different types of surfaces are listed below and followed by specification for each:

1. System No. 2 Submerged Metal – Potable Water

a. Application: Finish coating of fusion bonded epoxy pipe within the tank.

b. Surface Preparation: Where metal is fusion bonded epoxy, solvent clean and scuff clean by hand with 80 grit sand paper prior to coating application to remove shine and provide suitable substrate for bonding to epoxy.

c. Material: Polyamide Epoxy

Application	Material	Cover, MDFTPC
Primer	Modified Polyamide Epoxy	3 mils
Finish	Modified Polyamide Epoxy	4 mils

d. Standard of Quality: Tnemec Pota-Pox V140; or equivalent products.

e. Color: Intermediate coats shall be contrasting colors. Finish coat shall be tank white.

2. System No. 3 Concrete – Tank Exterior

a. Application: All exposed concrete tank exterior walls.

b. Surface Preparation: Complete and cure stucco and concrete construction for 30 days or more before starting surface

preparation work. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods. Clean surfaces of mortar and grout spillage and other surface deposits using one of the following: Nonmetallic fiber brushed and commercial muriatic acid followed by rinsing with clean water, or brush-off blasting.

c. Material: Apply one pretreatment coat of Tnemec Series 151, or equal, to a dry film thickness of 1 mil (.001) MDFTPC. Next apply two coats of Tnemec Series 156, or equal, 6 mils each coat, MDFTPC.

d. Pretreatment Color: Manufacturer's Standard

e. Finish Colors: Contrasting colors from suppliers color selection charts.

3. System No. 4 Exposed Metal and Plastic – Chemical Rooms

a. Valves, supports, pipe, equipment, and other miscellaneous metal surfaces within the Chemical Rooms. Where metal is galvanized, pretreat with Paint System 12.

b. Surface Preparation. Wire brush clean for shop applied primers (SP2). Power Tool Clean (SP3) for uncoated metal. Hand sand plastic surfaces to be coated with a medium grit sandpaper to provide tooth for the coating system. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material and adjacent surfaces are not damaged.

c. Material: Modified Epoxy. Converted epoxy containing rust-inhibitive pigments.

Application	Material	Cover
Primer	Polyamide Epoxy Primer	1 coat, 5 MDFT
Finish	Polyamide, Anticorrosive Epoxy	1 coat, 5 MDFT

d. Standard of Quality: Tnemec Chembuild, Series 135; Tnemec Epoxoline II, Series V69F; or equal.

e. Color selected by Engineer from color charts. Chlorine piping shall be safety yellow.

4. System No. 5 Exposed Metal – Mildly Corrosive

a. Application: Exposed piping, vaults, and all exposed metal including pumps, suction barrels, valves, supports, vent piping, and equipment, and other miscellaneous metal surfaces, except electrical panels and other equipment which may be factory finished coated by the manufacturer. The pumps and motors shall be shipped with a compatible shop applied prime coat and the final coat shall be field applied as specified herein. Where metal is galvanized, pretreat with Paint System 12. Where metal is fusion bonded epoxy, solvent clean, and scuff clean with 80 grit sand paper prior to coating application.

b. Surface Preparation: Solvent Cleaning (SP 1) and wire brush cleaning for shop applied primers. Power tool clean (SP3) for uncoated metal.

c. Material: Modified Epoxy. Converted epoxy containing rust-inhibitive pigments.

Application	Material	Cover
Primer	Polyamide, Epoxy Primer	1 coat, 5 MDFT
Finish	Polyamide, Anticorrosive Epoxy	1 coat, 5 MDFT

d. Standard of Quality: Tnemic Chembuild Series 135, Tnemec Epoxoline II, Series V69F; or equal.

e. Color selected by Engineer from color charts.

B. System No. 6 Exposed Metal – Atmospheric (Not Used)

C. System No. 8 PVC – Interior and Exterior

1. Application: All exposed PVC pipe or other plastic surfaces not in the Chemical Rooms shall be coated with System No. 8.

2. Surface Preparation: Hand sand plastic surfaces to be coated with a medium grit sandpaper to provide tooth for the coating system. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material and adjacent surfaces are not damaged.

3. Material: Apply two coats of Acrylic Latex, 320 SFPGPC, to interior surfaces, apply one coat Polyurethane Enamel, 320 SFPGPC, to exterior surfaces.

4. Color selected by Engineer from color charts. Chlorine piping shall be safety yellow.

D. System No. 10 Underground Piping Appurtenances

1. Application: Unless otherwise specified or factory painted with an approved system, buried pipeline items, such as valves, couplings and bolts shall be coated with this system.

2. Surface Preparation: Apply only to clean, dry surfaces. Remove rust, paint and other foreign matter wire brushing or scraping.

3. Material: Carboline Bitumatic 50, Polyguard CA-14 Mastic, or approved equal. Apply two coats, 18 mils total.

E. System No. 12 Metal – Galvanized, Aluminum, Copper

1. Application: All galvanized metal. Aluminum, copper and brass to be painted shall be pretreated in accordance with this system.

2. Surface Preparation: Surfaces shall be solvent cleaned in accordance with SSPC-SP-1, “Solvent Cleaning”. All surfaces shall be aggressively scarified to produce a profile between 1.0 and 1.5 mils.

3. Material: Apply one pretreatment coat of Tnemec Series 69, or equal, to a dry film thickness of 2 mil. Next apply the recommended coating or paint for the particular surface to be painted.

F. System No. 102 Masonry – Exterior (Not Used)

G. System No. 103 Masonry – Interior (Not Used)

H. System No. 103A Masonry – Chemical Rooms – Interior (Not Used)

I. System No. 104 Gypsum Wall Board – Interior (not Used)

3.06 SURFACES NOT TO BE PAINTED

A. Unless otherwise specified, the following surfaces shall be left unpainted:

1. Stainless Steel
2. Machined Surfaces
3. Glass
4. Aluminum
5. Electrical Conduits

END OF SECTION

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SECTION 09901

FILTER AND BACKWASH TANK COATING SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. All exposed metal and steel pipes and mechanical equipment associated with the Manganese Filter and Backwash Tank and except for the following:

a. Stainless steel

b. Rubber

c. Plastic pipe, including polyvinyl chloride and similar items

d. Nameplates and grease fittings

e. Pre-finished or anodized aluminum

B. Related Sections:

1. Section 09900, Coating Systems

2. Section 15050, Piping Systems (Piping, Fittings, Valves and Meters)

C. The Contractor is to base this bid on using the products specified. If the products specified are not available or not available in formulations that meet applicable regulations on volatile organic compounds (VOC) levels at time of application, the Contractor is to submit for review products of equivalent quality and function that comply with regulations in effect at that time.

D. The backwash tank shall be lined and coated per AWWA D102, latest edition, and as specified.

1.02 REFERENCES

A. American Water Works Specifications (Latest Addition):

1. AWWA C210 – Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines

2. AWWA C213 – Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

3. AWWA D102 – Coating Steel Water-Storage Tanks

B. National Sanitation Foundation (Latest Addition):

1. NSF 61 – Drinking Water System Components Health Effects

C. SSPC – Steel Structures Painting Council Specifications

D. ASTM D2200 – Pictorial Surface Preparation Standards for Painting Steel Surfaces

1.03 DEFINITIONS

A. Dry Film Thickness (DFT) – The fully cured applied paint thickness for each coat.

B. Exterior Surface – Surface that is not inside a building or structure and is exposed to the weather.

C. Stripe Coat – Coating applied to the edge, corner, welds or bolts, which is applied prior to application of additional system coats.

D. Submerged – Surfaces that are under water or the vertical extension of those walls that are partly under water during normal operating conditions.

E. Definition of Painting Terms: ASTM D16

1.04 SUBMITTALS

A. Submit in accordance with Section 01330, Submittals.

B. Prior to ordering material, submit a complete schedule of materials to be used. Include the manufacturer's brand name, product name, and designation number for each coat of each system to be used. Include statement as to VOC compliance with air quality standards within the County of Sacramento, CA.

C. Prior to commencing work, submit a detailed list of all surfaces and equipment items upon which the Contractor intends to apply protective coatings.

D. If materials other than those listed are submitted, submit additional information to fully define the proposed substitution. The Engineer may further require the Contractor to furnish additional test results from an independent paint laboratory comparing the proposed substitution with one of the named products, at no additional cost.

E. Provide Material Safety Data Sheets (MSDSs) for all products.

F. Manufacturer’s Certification – That products furnished meet applicable Air Quality Management District regulations as to allowable volatile organic compound (VOC) content for the place of application and use intended.

G. Color chart for each coating for color selection by the City. Submit color chart two (2) weeks in advance of required pre-painting conference and walkthrough.

1.05 PRE-PAINT CONFERENCE AND WALKTHROUGH

A. Schedule with the Engineer a pre-paint conference and walkthrough of the backwash tank and filter two (2) weeks prior to start of field painting or coating to ensure the paint and coating products and colors are properly selected and allow coordination with other trades.

1.06 QUALITY ASSURANCE

A. Environmental Regulatory Requirements:

1. All work, material, procedures, and practices under this Section shall conform to requirements of the local Air Resources Board or Air Quality Management District having jurisdiction. Prime or finish coat painting done in locations other than the project site shall be in accordance with air quality regulations in effect at the place the coating is applied. Contractor is responsible to confirm that products proposed are in compliance with the applicable volatile organic compounds (VOC) levels allowable at the date these Specifications were issued for bid.

2. The Air Resources Board or Air Quality Management District having jurisdiction may prohibit the sale or application of paints and enamels containing more than the stipulated percentages of volatile organic solvents manufactured after a stated date. Provide material meeting applicable regulations effective at the date of manufacture or, if not available, provide top of the line materials developed as replacements for specified materials and meeting applicable regulations as to VOC solvents content.

3. If the Contractor applies coatings that have been modified or thinned other than as recommended by manufacturer, they will be responsible for any fines, costs, remedies or legal actions that may result.

1.07 WARNINGS

A. Be advised that as a part of this work abrasive blasting is required. This may require the use of special equipment. Become familiar with the existing site conditions and take all steps necessary to protect adjacent facilities and personnel, at no additional cost to the City.

B. The Contractor shall furnish all labor, equipment and means required and shall carry out protective measures wherever and as often as necessary to prevent their operations from producing overspray or dust in amounts damaging to property or causing nuisance. The Contractor shall be responsible for any damage resulting from overspray or dust originating from their operations. The abatement measures shall be continued until all surface preparation and painting is completed. All compensation to be received for overspray and dust abatement shall be included in the prices named for appropriate items of the bidding schedule.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver all coating materials in unopened containers with the manufacturer's label which must include name, batch number, and date and VOC content.

B. Store in an assigned area onsite with concurrence from the coating manufacturers. Maintain storage area clean and fire safe. Dispose of used rags, thinner and buckets daily. Solvents shall be stored in closed approved storage containers.

1.09 COATING CONTRACTOR REQUIREMENTS

A. The field coating activities under this Section shall require a C-33 painting and decorating license. The Contractor shall have a foreman with a minimum of 5 years of practical experience in the application of the specified coating products to surfaces at similar facilities on site at all times during any site preparation and coating activities under this Section.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Paints used in each system shall be the product of one manufacturer.

B. Only compatible materials shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats.

C. Coating systems shall not contain lead.

D. Coatings in contact with potable water shall be NSF 61 certified.

E. Abrasives shall not be classified a hazardous material under California Title 22.

F. Materials – Paints and protective coatings listed in the Paint Systems and the Schedule in Part 3 of this Section refers to the following manufacturers and is specified as levels of quality. It is understood that the words "or equal" are included herein.

G. No request for substitution of an “equal” will be considered which decreases the film thickness designated, the number of coats to be applied, solids content by volume, the general type of coating, paint, or primer, or the quantity, quality and type of ingredients in the coatings specified. The Contractor shall provide a list of reference where coating of the same generic type has been applied on similar projects. The reference list shall give the project name, city, state, phone number of city, coating system reference and number, and year coating was applied. Coatings not listed in the specifications shall be submitted with certified ingredients analysis so that a complete comparison between specified and proposed coating may be made.

Sherwin Williams	CRC Industries
Kop Coat	Roto Metals
Tnemec Co.)	Protecto Wrap
Chemical Products Co.	Tapecoat
Amercoat	Or an approved equal

2.02 COLORS AND SAMPLES

A. Colors are to be factory mixed, using light-fast colorants proportioned by accurate measurement into proper type base. All coatings must be formulated to perform in the climate and environment to which they will be exposed.

B. Finish colors shall be as selected by the City from the manufacturer’s standard color samples.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION AND APPLICATION

A. Field Coating – Prepare surfaces in strict accordance with the manufacturer’s instructions prior to application. Provide the manufacturer’s instructions with submittal. Apply first coat immediately after surface preparation. Keep all paints at a consistency and applied in accordance with the printed directions of the manufacturer. The painting shall be done by hand, spray, or roller as approved by the manufacturer’s recommendations. The Engineer and Contractor will review all surfaces to be painted on the job prior to application of any coatings. Once the Contractor begins undercoating or priming, this will be his guarantee that the surface is acceptable to paint. All painted surfaces are to be free from drips, ridges, holidays and brush marks. The following stipulations also apply:

1. Thinning permitted only when recommended by the manufacturer and only with thinner recommended for use with the particular product.

2. The use of additives to improve working characteristics or to lengthen or shorten set time is prohibited.

3. Items difficult or impossible to paint after installation are to be painted before installation and touched up after installation.

4. Apply each coat to a uniform, even coating; lay material on in one direction and finish at right angles. Allow material to thoroughly dry between coats. Scuff, sand, runs, sags, overspray, surface roughness, and other defects shall be removed between each coat. Dust and wipe surface clean before applying next coat.

5. Apply no less than the number of coats or dry film thickness specified. Apply additional coats if required for uniform coverage, full hiding, and to achieve file continuity. Finished work is to be uniform in color, full coverage, smooth and free of sags and brush marks.

6. Apply each coat on all work only after all major construction is inactive and the work areas have been cleaned up and are dust free.

7. Apply all coatings within the manufacturer’s recommended recoat window. If a topcoat passes the recoat window, submit a letter from the coating manufacturer stating what is required before the topcoat can be applied. Do not apply topcoat until the corrective action has been favorably reviewed by the Engineer.

8. Coat abrasive blast-cleaned surfaces with primer before visible rust forms. Apply painting system within 8 hours of blast-cleaning the surface.

3.02 FIELD QUALITY CONTROL

A. Pinhole and Continuity Testing:

1. After the application of the prime and finish coats of Paint Systems A, B and F, perform continuity and pinhole checking by means of a low voltage electrical resistance meter and check thickness with a magnetic thickness gauge to determine that pinhole free condition and specified film thickness of the paint system has been achieved over all of the painted surfaces. Repair all deficiencies in film integrity and thickness in accordance with the manufacturer's instructions. The Contractor shall provide pinhole and continuity testing equipment, conduct the test, and provide the test results to the Engineer. Notify the Engineer when the test will be held by at least 14 calendar days. The Engineer may elect or witness the test.

2. The Engineer or its independent testing consultant may perform its own continuity and pinhole checking and thickness checks in addition to the Contractor's required tests. The appropriate equipment and necessary support, if requested, is to be provided by the Contractor. Repair any additional deficiencies in film integrity and thickness per the manufacturer's instructions and to the satisfaction of the Engineer.

3. Attention is directed to the fact that past use of the low voltage electrical resistance meter has demonstrated that the painter must apply at least two and usually three or more stripe coats along all edges, angles and crevices formed by joining member in addition to the coats specified in order to achieve a pinhole free surface.

B. Adhesion Testing – Where there is a question of paint or coating adhesion to surfaces, demonstrate to the Engineer's satisfaction that the coating adhesion to the area in question is equal to or greater than that which the paint manufacturer literature states may be achieved by his product. An "Elcometer Adhesion Tester" shall be provided by and used by the Contractor to accomplish this test.

C. Continuity, Pinhole, and Adhesion Testing Support – Provide scaffolding, ladders, lighting, and labor as required to facilitate the Engineer's check. Repair any areas damaged during and by the testing operation.

D. Environmental Conditions:

1. Measure and record the temperature, dew point, and humidity daily (at the start of the day, prior to painting, and if conditions deteriorate). Maintain the records in a place where the Engineer can check them. Submit the records to the Engineer at the end of the project.

2. Coatings shall be applied only to surfaces that are dry, and only under such atmospheric conditions as will cause evaporation rather than condensation. Coating shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10°F of the dew point, the surfaces shall be heated to prevent moisture condensation thereon.

3. Bare metal surfaces, except those which may be warped by heat, may be dehydrated by flame heating devices immediately prior to coating application. During coating, and for a period of at least 8 hours after the coating has been applied, the temperature of the surfaces to be coated, the coated surfaces, and the atmosphere in contact shall be maintained at or above 50°F and not less than 10°F above the dew point. Coating, when applied, shall be approximately the same temperature as that of the surface on which it is applied. Fans or heaters shall be used inside enclosed areas where conditions causing condensation are severe.

4. Coating shall not be applied on surfaces hotter than 120°F.

3.03 QUALITY OF LINING AND COATING APPLICATION

A. The cured lining or coating shall be smooth and glossy with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

3.04 CLEANING AND COMPLETION

A. At the completion of this portion of the work, remove all debris, remove all paint and stains from work for which paint finish is not intended, touchup all marred surfaces, and leave all buildings and structures in a clean condition, ready for use.

B. Refinish all damaged or imperfect painting to the satisfaction of the Engineer prior to final acceptance of the facility.

C. Finish work, except waterproofing mastics, is to present an even, pleasing and uniform color and appearance. Surfaces exhibiting coatings with shadows, streaks, overlap marks, sags, drips, roughness or non-uniform sheen will be considered as improperly applied and will not be considered acceptable.

D. Leave all machinery nameplate data tags clean and readable and all grease fittings clean and usable. Clean paint from windows and electrical equipment provided with factory coatings.

3.05 SPARE PAINT

A. Furnish one-gallon (minimum) container of each type and color of finish product used. Label containers. Each product shall have a minimum of 11 months of shelf life at project completion.

3.06 COATING SYSTEMS

A. The coating systems listed are for the welded steel backwash tank and filters. All other submerged metalwork, equipment, and exposed pipe associated with the filter or backwash tank shall be coated per Section 09900. Coatings for filters may be shop applied.

B. Surface Preparation

1. All metal surfaces (non-galvanized) shall be field sandblasted according to SSPC-SP-10, “Near-White Metal Blast Cleaning”, to provide a surface profile of 1.5 to 2 mils.

2. All metal surfaces (non-galvanized) shall be field sandblasted according to SSPC-SP-10, “Near-White Metal Blast Cleaning”, to provide a surface profile of 1.5 to 2 mils.

a. For non-ferrous and galvanized metal, pretreat with Paint System B-2b

C. Interior Coating

1. Interior coating shall have three coats minimum applied of a high solids epoxy

2. DFT = 12-15 mils

3. Acceptable products

a. Amercoat 395FD,

b. Tnemec Series 140, Pota-Pox Plus

c. or an approved equivalent

D. Exterior Coating

1. 1st Coat (s)

a. High solids epoxy

b. DFT = 6 mils

c. Acceptable products

1) Amercoat 400

2) Tnemec, Series 135

2. Finished Coat

a. Aliphatic Polyurethane

b. DFT = 3 mils additional

c. Acceptable products

1) Amercoat 450HS

2) Tnemec Series 74

3.07 SURFACES NOT TO BE PAINTED

A. Unless otherwise specified, the following surfaces shall be left unpainted:

1. Stainless Steel
2. Aluminum
3. Butterfly Valve Actuator
4. Concrete
5. Glass
6. Machined Surfaces
7. Equipment Nameplates
8. Transducers

END OF SECTION

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SECTION 09902

ACRYLIC WATER REPELLENT

PART 1 - GENERAL

1.01 SUMMARY

A. This section specifies the application of an Acrylic Water Repellent on the exterior of the split face concrete masonry unit walls of the Control Building.

1.02 QUALITY ASSURANCE

A. Follow manufacturers recommended procedure for the exterior surface preparation of concrete masonry units.

B. Coating Contractor:

1. The Coating Contractor shall hold a current C-33 painting and decorating license and have a minimum 5 years practical experience in the application of specified products to surfaces at similar facilities.

1.03 SUBMITTALS

A. The Contractor shall submit information to substantiate compliance with this specification in accordance with Section 01330, Submittals. In addition, the following specific information shall be provided.

B. Material Safety Data Sheets (MSDSs) for all products.

C. Letter from manufacturer stating that product is suitable for intended use and is compatible with and will not cause discoloration of masonry units.

D. Field conducted water spray test results.

E. See Paragraph 2.01, Materials, for additional submittal requirements for products not named in the specifications.

F. Warranty as required in Section 01781.

G. Provide manufacturer's standard 5-year performance warranty.

1.04 DELIVERY AND STORAGE

A. All materials shall be delivered to the site in the manufacturer’s sealed containers. Each container shall be labeled by the manufacturer, and shall be intact upon delivery. Labels shall give the manufacturer’s name, brand, type of paint, batch number, color of paint, date of manufacture, storage life, and instructions for reducing.

B. The Contractor shall store all materials and equipment in a storage place protected from weather and excessive heat and cold. Necessary precautions shall be taken to reduce hazards to a minimum. Materials exceeding the storage life recommended by the manufacturer shall be removed from the site.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Liquid Water Repellent: Clear, non-staining, non-yellowing, deep penetrating silane sealer.

2.02 ACCEPTABLE MANUFACTURERS

A. The following manufacturers are acceptable for Liquid water repellent:

1. L & M Construction Chemicals (Pentane WB40).
2. Nox-Crete Chemicals Inc. (Stifel VC).
3. Or an approved equivalent

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect adjacent surfaces not intended to be covered.

B. Clean surfaces to be covered in accordance with manufacturer's recommendations.

C. Make all mortar repairs at least 48 HRS prior to application.

D. Allow masonry surfaces to cure minimum of 10 days prior to application.

3.02 INSTALLATION AND APPLICATION

A. Install products in accordance with manufacturer's instructions.

1. Apply as much material as required to obtain results required by Paragraph 3.03, but as a minimum, apply material in accordance with manufacturer's recommendations.

B. Apply to exterior concrete block surfaces.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's designated representative shall conduct a water spray test to an area of wall for a period of 3 HRS. Water from the spray shall impact the wall at a 45-degree angle to the vertical and shall cover an area of not less than 9 SF. Water flow shall be minimum 5 GPM at 60 PSI pressure. If, within 3 HRS, water transmission appears on the inside face of the wall within the test area, the wall shall be recoated.

B. Retest as required.

C. Recoat as required until wall area remains dry within limits of testing procedure.

D. Results of this test shall be used to determine material quantity in excess of manufacturer's minimum recommended amounts to be applied per square foot to the building wall.

E. Protect adjacent materials not required to be coated.

3.04 ATMOSPHERIC CONDITIONS

A. Follow manufacturer's recommendations for application conditions.

END OF SECTION

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SECTION 09910

ARCHITECTURAL PAINTING

PART 1 - GENERAL

1.01 SUMMARY

A. Scope of Work

1. The requirements and products listed in this specification shall only apply to the interior and exterior painting of the masonry building, and painting of the air louvers doors, gutters, roof flashings, downspouts, and other architectural elements of the masonry building.

B. The qualified painting contractor shall furnish all labor, materials, equipment, services, and facilities necessary for the satisfactory completion of the project.

C. All unfinished surfaces shall be painted.

D. General Requirements:

1. Materials for the project shall be of the highest grade products regularly manufactured by the paint manufacturer and conforming to the paint specifications outlined below. Paint materials shall be delivered in sealed containers that plainly show the designated product name, batch number, color, manufacturer's directions for application, and name of manufacturer. The paint shall be free of lead and other material which will be toxic to personnel under normal conditions of use.

1.02 REFERENCED SECTIONS

A. The following Sections are reference in this Section

1. Section 01330- Submittals

2. Section 09902 – Acrylic water Repellents

1.03 QUALITY ASSURANCE

A. Follow manufacturers recommended procedure for surface preparation.

B. Painting Contractor:

1. The painting Contractor shall hold a current C-33 painting and decorating license and have a minimum 5 years practical experience in the application of specified products to surfaces at similar facilities.

1.04 SUBMITTALS

A. The Contractor shall submit information to substantiate compliance with this specification in accordance with Section 01330, Submittals. In addition, the following specific information shall be provided.

1. Material Safety Data Sheets (MSDSs) for all products.

2. Complete data on each of painting and primer. This shall be done whether or not the product is named herein. Manufacturer's published application instructions.

3. Color chart for each paint for color selection by Owner. Submit color chart two (2) weeks in advance of required pre-painting conference and walk through.

4. See Subsection 2.01, Materials, for additional submittal requirements for products not named in the specifications.

1.05 DELIVERY AND STORAGE

A. All materials shall be delivered to the site in the manufacturer's sealed containers. Each container shall be labeled by the manufacturer, and shall be intact upon delivery. Labels shall give the manufacturer's name, brand, type of paint, batch number, color of paint, date of manufacture, storage life, and instructions for reducing.

B. The Contractor shall store all paint materials and equipment in a storage place protected from weather and excessive heat and cold. Necessary precautions shall be taken to reduce hazards to a minimum. Materials exceeding the storage life recommended by the manufacturer shall be removed from the site.

1.06 PROTECTION FROM OVERSPRAY AND DUST

A. The Contractor shall furnish all labor, equipment and means required and shall carry out protective measures wherever and as often as necessary to prevent their operations from producing overspray or dust in amounts damaging to property or causing nuisance. The Contractor shall be responsible for any damage resulting from overspray or dust originating from their operations. The abatement measures shall be continued until all surface preparation and painting is completed. All compensation to be received for overspray and dust abatement shall be included in the prices named for appropriate items of the bidding schedule.

PART 2 - PRODUCTS

2.01 MATERIALS

A. All paint and coating materials furnished for each coating system shall be the products of a single manufacturer.

B. Only compatible materials shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats.

C. The volatile organic content (VOC) of the applied coatings, as determined in accordance with ASTM D3960, shall comply with current air pollution regulations.

2.02 ACCEPTABLE PAINTING MANUFACTURERS

A. Manufacturers:

1. Dunn Edwards

2. Pittsburgh Paint

3. Or approved equal

2.03 COLORS

A. All colors and shades of colors of all coats of paint shall be as indicated or selected by the City. Finish colors shall be as selected form the manufacturer's standard color samples for premixed stock paint colors as selected by the City.

PART 3 - EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that substrate conditions are ready to receive work.

3.02 PAINT APPLICATION AND WORKMANSHIP

A. All work shall be of a quality that will give the best possible finish and which will provide the maximum durability which can be reasonably expected from a painted surface. The finished surfaces shall be free from "holidays", runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The coverage shall be complete, and when necessary, a second coat or more shall be applied to provide complete coverage and to produce a uniform thickness. All paint materials shall be applied in accordance with manufacturer's instructions and local regulations. Special attention shall be given to ensure that all surfaces including edges, corners, and crevices receive a firm thickness equivalent to that of adjacent painted surfaces.

B. If proper lighting does not exist in the unit, the Contractor shall be responsible to provide adequate lighting during painting and inspection.

C. Care shall be exercised to prevent paint from being spattered onto surfaces which are not to be painted. Surfaces from which paint cannot be satisfactorily removed shall be repaired/replaced or painted, as required, to produce a finish equal to the quality specified for newly painted or finished surfaces.

D. All moving parts (i.e., hinges) shall be left in proper working order.

E. Sufficient time, as recommended by the manufacturer, shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit adverse weather conditions. Paints shall be considered dry for re-coating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause lifting or lose adhesion of the undercoat.

F. All door hardware shall be installed after painting.

3.03 MIXING AND THINNING

A. Paint shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Where necessary to suit conditions of surface, temperature, weather, and method of application, packaged paint may be thinned immediately prior to application in accordance with the manufacturer's directions. The use of thinner for any reason shall not relieve the Contractor from obtaining complete coverage.

3.04 ATMOSPHERIC CONDITIONS

A. Follow manufacturer's recommendations for application conditions.

3.05 CLEANING

A. As work proceeds, promptly remove finishes where spilled, splashed, or splattered.

B. During Painting Operations:

1. Contractor shall remove dirt, debris, waste rubbish, and implements of service from the buildings, the work area, and the site at the end of each day. Debris, waste, or unused materials shall not be left under, in, or about the buildings and shall be disposed of off the site every day. All paint materials, tools, clothing, oily rags, and waste must be removed from the buildings every night at an approved location. DO NOT dispose of any painting materials in the area's toilets, sinks, grounds, or sewers.

C. At Completion of Work: All glass, hardware, anodized surfaces and working areas where painting has been done shall be cleaned of all paint over spray, drips, splatters, etc.

D. Remove from the premises all tools, surplus materials, debris, scaffolding, equipment each day. Clean the areas thoroughly and remove all marks, stains, fingerprints, dust, paint drippings, and the like from the premises.

E. All paint shall be stored in a secure location every night to prevent vandals from tampering with the paint.

3.06 SCHEDULE – SHOP PRIMED ITEMS FOR SITE FINISHING

A. Exterior Doors:

1. One (1) coat of etching primer.

2. Two (2) coats of 100% acrylic semi-gloss latex.

3.07 SCHEDULE – EXTERIOR SURFACES

A. Steel – Galvanized: Gutters, flashings, louvers, etc.

1. One (1) coat of metal primer.

2. Two (2) coats of enamel, gloss.

3.08 SCHEDULE – MASONRY BUILDING SURFACES

A. Interior

1. One (1) coat Dunn Edwards "Blocfil" medium W604 or approved equal.

2. One (1) coat Dunn Edwards "Super-Loc" W718 or approved equal.

3. Two (2) coats Dunn Edwards "Endurawall" W370 100% acrylic elastomeric wall coating or approved equal.

B. Exterior

1. See Specification Section 09902.

3.09 SCHEDULE – DRYWALL SURFACES

A. Level 4 Finish: Tape embedded in joint compound and wiped with a joint knife, leaving a thin coat of compound over tape. Joint compound shall be smooth and

free of tool marks and ridges. The prepared surface be coated with a drywall primer prior to the application of final finishes.

B. Interior primer/sealer: One (1) coat of Devoe Paint Drywall Primer DRN54301 or approved equivalent.

C. Topcoat: Two (2) coats of Devoe Velour Semi-Gloss Interior Alkyd Enamel or approved equivalent.

3.10 SCHEDULE – FASCIA SURFACES

A. Primer/sealer: One (1) coat of Dunn Edwards “EZ-PRIME” Premium Exterior Wood Primer EZPR00-1 or approved equivalent.

B. Topcoat: Two (2) coats of Dunn Edwards “Evershield” Exterior/Interior Semi-Gloss Paint EVSH50-2 or approved equivalent.

3.11 SURFACES NOT TO BE PAINTED

A. Unless otherwise specified, the following surfaces shall be left unpainted:

1. Stainless Steel
2. Aluminum
3. Hot Dip Galvanized Items
4. Rotork Actuator
5. Concrete
6. Glass
7. Equipment Nameplates

END OF SECTION

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SECTION 10200

WARNING SIGNS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Informational and accident prevention signs.

1.02 REFERENCED SECTION

A. The following Section is referenced in this Section:

1. Section 01330 - Submittals

1.03 SUBMITTALS

A. Submittals shall demonstrate full compliance with all aspects of this specification, and be submitted in accordance with section 01330.

PART 2 - PRODUCTS

2.01 WARNING SIGNS

A. Accident prevention signs shall conform as to design with OSHA Section 1910.145 of Subpart J, Part 1910, Chapter XVII, Title 29 of the Code of Federal Regulations. Exit signs shall conform with the OSHA Safety and Health Standard for General Industry, the Uniform Fire Code, and local fire regulations

B. The sign type shall be as follows:

Type	Message
I	CAUTION—AUTOMATIC EQUIPMENT MAY START AT ANY TIME
II	DANGER—480 VOLTS
III	EXIT

C. Signs shall be distributed as follows:

Location	Number	Type	Mount
All 480V Switchgear	2	II	Wall
All 480V Motor Control Centers	2	II	Wall
PLC Controlled Pumps	4	I	Post
Exterior Doors	6	III	Door

D. Signs shall be constructed with a flat sheet of aluminum for door or wall mount. Sign size shall be 10” x 14”. The sign face shall be three mm (0.125”) thick aluminum with surface applied reflective vinyl graphics. Sign is to be installed with mechanical fasteners into wall or door surface. No exposed support brackets are allowed.

E. Mount signs in proper alignment, level and plumb. Where otherwise not dimensioned, signs shall be installed where best suited to provide a consistent appearance throughout the project. When exact position, angle, height or location is in doubt, contact the Engineer for clarification.

F. Sign post shall be constructed of an extruded aluminum square post, minimum three mm (0.125”) wall thickness, with an aluminum plate sign panel. Mechanically fasten sign to support post with tamper resistant fasteners. Post caps shall be welded or mechanically attached with concealed fasteners. Post signs shall be installed with a base plate and expansion anchor bolt mounting into concrete.

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 10300

BIRD REPELLER

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section specifies system for repelling birds from the reservoir roof.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals

1.03 SUBMITTALS

A. Submittals shall demonstrate full compliance with all aspects of this specification, and be submitted in accordance with section 01330.

PART 2 - PRODUCTS

2.01 ELECTRONIC BIRD CONTROL

A. Bird repelling device based on audible distress signals broadcast through high fidelity weather-resistant speakers.

B. Unit to consist of solid-state electronics mounted inside a NEMA control box suitable for outdoor weather.

C. Programmable with adjustments for volume, specific sound combinations, daylight, night, or 24-hour operation with a randomly selected frequency.

D. Provide four different random features that vary the sound, the sound duration, length of time between sounds and the sound location.

E. Unit shall be as manufactured by Bird Gard Pro or equal.

F. Provide sound generating unit with built-in speaker, built-in sound chip with 8 different sounds, power adapter with 50 feet of cable, mounting hardware and bracket.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount to side of concrete wall at access hatch.

END OF SECTION

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SECTION 10520

FIRE EXTINGUISHER

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the fire extinguisher that shall be located in the control building's electrical room.

1.02 QUALITY ASSURANCE

A. Referenced Standards:

1. National Fire Protection Association (NFPA):

a. 10, Standard on Portable Fire Extinguishers

2. Underwriters Laboratories, Inc. (UL).

a. Building Materials Directory

3. Factory Mutual System (FM):

a. Approval Guide - Latest Edition

1.03 1.03 SUBMITTALS

A. Shop Drawings:

1. See Section 01330

2. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced

b. Manufacturer's installation instructions

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver and install filled and charged extinguisher just prior to building occupancy

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. The following manufacturers are acceptable:

1. Fire extinguishers:

a. J L Industries

b. Larsen's Manufacturing Co

c. Muckle Manufacturing

d. Amerex Corporation

e. Ansul Fire Protection

f. Walter Kidde

g. Master Protection Enterprises
h. Potter - Roemer Inc.
i. Or equal

2.02 MANUFACTURED UNITS

A. Wall Brackets:

1. Bracket type to fit specified extinguisher, with correct mounting accessories to fit substrate.
2. Furnish bracket for each extinguisher not in cabinet.

B. Fire Extinguisher:

1. Steel bodied, all metal top (head) and valves
2. Multi-purpose dry chemical, UL Rated, 20A-120BC
3. Provide hose and horn on each
4. Furnish one fire extinguisher at location directed by the Engineer
5. Finish: Red with epoxy finish coat
6. Provide "FIRE EXTINGUISHER" decal for each extinguisher
7. Meet NFPA 10

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions
B. Install units with extinguisher top not over 48-in above floor
C. Install FEC with top of unit at 60-in above floor

3.02 SCHEDULE

A. Control building’s electrical room (1)

END OF SECTION

SECTION 11001

GENERAL EQUIPMENT AND MECHANICAL

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The provisions of this Section are the general requirements for all of the Equipment and Mechanical work in the scope of the Project, Divisions 11, 15, and 16, and wherever specifically required in these Specifications.

B. The Contractor shall direct the attention of all subcontractors and suppliers of equipment and related appurtenances for the work to the applicable provisions in the Contract Documents wherever they may occur.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 09900 – Coating Systems

1.03 STANDARDS FOR THE WORK

A. Complete Systems: Pipe, fittings, wiring and supports shall be provided to produce complete, operable systems with all elements properly interconnected as shown in schematic diagrams or to provide specified operations. If a specific dimensioned location is not shown for interconnections or smaller system elements, the Contractor shall select appropriate locations and show them on Shop Drawing submittals for review.

B. Equipment and material shall be new and without imperfections and shall be erected in a neat and workmanlike manner; aligned, leveled, cleaned and adjusted for satisfactory operation; installed in accordance with the recommendations of the manufacturers and the best standard practices for this type of work so that connecting and disconnecting of piping and accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance and repair. Oil and lubrication fittings shall be located clear of and away from guards, base, and equipment and within reach from the operating floor. In order to meet these requirements with equipment as furnished, minor deviation from the Drawings may be made as favorably reviewed by the Engineer.

1.04 MANUFACTURER'S INSTRUCTIONS

A. The recommendations and instructions of the manufacturers of products used in the work are hereby made part of these Specifications, except as they may be superseded by other requirements of these Specifications.

B. Shop Drawings:

1. Shop Drawings shall be submitted to the Engineer and approved prior to fabrication, construction or delivery to the project site in accordance with the Special Conditions of these Specifications, showing sizes and arrangement of equipment, foundations and anchor bolts required, performance characteristics, fan curves and pump curves, control

diagrams, wiring diagrams, motor data sheets, methods of assembly, pipe hanging details, ductwork layouts and connections to other work.

2. Drawings shall be dated and signed as certified for use in construction of this project.

3. The arrangement of mechanical equipment and appurtenant piping shown on the Drawings may be varied as necessary to fit the favorably reviewed certified manufacturer's installation Drawings. However, manufacturers' drawings shall not deviate in substance from the Contract Drawings and Specifications as to location, size, type and design of equipment.

C. The following minimum requirements shall accompany all equipment submissions:

1. Overall dimensions.

2. Mounting arrangement and dimensions.

3. Description of materials.

4. Connection sizes and orientation.

5. Capacity and location of lifting eyes.

6. Motor arrangement showing location of electrical connections.

7. Rating data — Mechanical and Electrical as applicable.

8. Detail electrical wiring diagrams, showing component designation and rating.

9. Seismic calculations (where specifically requested in the Specifications).

10. Motor data as specified in Division 16.

11. List of special tools and/or spare parts to be furnished, if any.

D. Each piece of equipment, for which certified witnessed or non- witnessed performance tests are required, shall be accompanied by a completed form which will contain at least the following information:

1. Owner's name and location of project.

2. Contractor's name and subcontractor if applicable.

3. Name of item being submitted.

4. Specification reference by section, paragraph and page.

5. Data on item (manufacturer, general descriptive data, dimensions, size of connections, speeds, performance curves, serial number).

6. Motor data, type, voltage, frequency, phase, full load amperes, starting method, frame size, enclosure insulation type (NEMA Code letter), dimensions, service factor, serial number.

7. Date and signature of person certifying the performance.

E. Refer to the Special Conditions for requirements relative to substitutions and modifications in the work to accommodate substitutions.

F. The Contractor shall ascertain the location of all motor connections in order to properly orient encased electrical conduits.

G. Instruction Manuals: Prepare and submit instruction manuals covering all equipment and machinery specified in Divisions 11, 15, and 16. Refer to the Special Conditions.

H. Manufacturers' Affidavits: Each equipment manufacturer, or his authorized representative, shall submit an affidavit in accordance with the Special Conditions and Part 3 of this section.

1.05 RESPONSIBILITY AND CARE OF EQUIPMENT

A. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested and accepted in accordance with the requirements of these Specifications.

B. The Contractor shall make his own provisions for properly storing and protecting all material and equipment against theft, injury or damage from any and all causes. Damaged material and equipment shall not be used in the work.

1.06 FACTORY TESTS

A. Factory tests shall be performed for each piece of equipment where specifically called for in the Section specifying that equipment. Note that factory tests are inherent in many reference standards. The requirement for a factory test in a referenced standard shall make that requirement a part of these Specifications. Conduct factory tests at the same speeds at which the equipment will operate in the field, except as noted.

B. Where specifically noted, performance tests may be witnessed by the Engineer. The Contractor shall inform the Engineer in sufficient time to allow arrangements to be made for witness of such tests. When non-witnessed tests are performed, certified results shall be supplied by the Contractor.

C. Factory testing of pumps shall be done in accordance with the requirements and Standards of the Hydraulic Institute. Tests of other equipment shall conform to the requirements set forth in these Specifications.

PART 2 - PRODUCTS

2.01 DESIGN

A. General: All equipment shall be designed for the service intended, shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection and during continuous or intermittent operation, shall be adequately stayed, braced and anchored, and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. Materials of construction shall be cathodically compatible.

B. Equipment, in general, shall be free-standing and shall be designed to be anchored to the floor unless otherwise shown. Anchorage to wall that restricts passageways or prevents operating and maintenance access shall not be acceptable.

C. Controls:

1. Unless noted otherwise, the design of the electric control of any equipment system and/or equipment package shall be the responsibility of the manufacturer of the equipment system and/or equipment package.

2. The elementary control diagrams as shown on the Electrical Sheets and the diagrams shown in the Instrumentation Specification Sections are illustrative of control and monitoring requirements pertaining to various equipment of this project.

3. The manufacturers shall design their own functional electric control devices and circuitry, in consultation with the specific elementary control diagrams and other project specifications, to meet the equipment control requirements.

4. All such systems and package controls shall be furnished by the equipment manufacturer, except that controls shown in motor control centers and process controllers, remote control devices, and their interconnecting wiring (other than 24 volt heating, ventilating and air conditioning circuits) shall be provided under Division 16.

2.02 MATERIALS AND STANDARD SPECIFICATIONS

A. Materials:

1. Design, fabricate and assemble equipment and systems with new materials and in accordance with acceptable modern engineering and shop practices.

2. Manufacture individual parts to standard sizes and gauges so repair parts can be installed in the field.

3. Make like parts of duplicate units interchangeable.

4. Do not place equipment in service at any time prior to delivery except as required for factory or shop tests.

B. Uniformity:

1. Unless otherwise specified, equipment or material of the same type or classification used for the same purpose shall be the product of the same manufacturer and shall be the same model.

2. Provide lubricants of types recommended by equipment manufacturers, in quantities sufficient for consumption prior to completion, testing and final acceptance.

3. Provide equipment lubrication systems that require attention no more often than weekly during continuous operation.

4. Provide access to lubrication points and/or extend lubrication fittings to operating level for easy access.

2.03 ANCHORS

A. Each equipment manufacturer shall furnish the required anchor bolts, nuts and washers of adequate design for securing bases and bedplates to concrete bases. Provide anchor bolts of length to allow for 1 1/2—inch of grout under baseplates and adequate anchorage into structural concrete unless otherwise shown or specified.

B. Anchor and assembly bolts and nuts shall be of ample size and strength for the purpose intended. All bolts shall be standard machine bolts, with cold pressed hexagon nuts. Unless otherwise specified or noted on the Drawings, materials shall be as follows: Bolts in submerged locations or submerged and embedded in

concrete or buried in earth shall be Type 304 stainless steel. Bolts for supports or equipment in dry or moist locations shall be galvanized steel, hot-dip, with oversize nuts. Provide suitable degauling compounds for bronze and stainless steel threaded components. Any space wholly or partially underground, or having a wall or ceiling forming part of a water channel, is classified as a moist location. Other bolting materials shall be used where specifically called for in Specifications or on the Drawings.

C. Anchor all motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive.

D. Anchor all non-motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive.

E. Cover fan blades, couplings, exposed shafts and other moving or rotating parts on all sides with safety guards conforming to all Federal, State, and local codes and regulations pertaining; conform to the most restrictive requirement. Design guards for easy installation and removal, complete with necessary supports, accessories, and fasteners, all hot-dip galvanized. Design guards in outdoor locations to prevent entrance of rain and dripping water. Provide tachometer test opening in line with ends of shafts. Typically, guards shall be expanded metal on a structural steel frame except that outdoor guards shall be of solid material. Expanded metal guards shall be stainless steel. Provide spring loaded hinged doors with latches for service and lubrication access. Guards shall comply with the requirements of these specifications, Cal/OSHA Standards, and “The Principles and Techniques of Mechanical Guarding” (OSHA 2057), whichever is more stringent.

2.04 LIFTING EYES

A. All equipment weighing over 100 pounds shall be supplied with lifting eyes. Parts of equipment assemblies which are normally serviced separately, such as motors, shall have lifting eyes of their own.

2.05 DRIVES

A. All drive units shall have an AGMA racing and service factor suitable for twenty-four hours per day operation under the operating load.

B. Drive unit housings shall be constructed of high grade cast iron, welded steel, or other suitable material.

C. Thermal rating of each unit shall exceed the design load or proper cooling devices shall be provided.

D. All drives shall be designed especially for the service for which they are to operate.

2.06 NAMEPLATES

A. Manufacturer’s Nameplate:

1. Each piece of equipment and its driver shall be furnished with a corrosion-resistant metal nameplate fastened to the item in an accessible position.

2. This nameplate shall contain the manufacturer’s name, equipment rating, capacity, size, model, serial number and speed.

3. Data for motors shall be NEMA standard. All information written or printed shall be in English.

4. Each item of equipment shall bear a different serial number. Measurement units shall be given for ratings and capacity.

5. Nameplates for tanks and pressure vessels shall give working pressure, test pressure, vessel plate thickness and ASME Code data.

B. Direction of Rotation: Each piece of rotating equipment shall have a direction of rotation arrow.

C. Meter and Gauge Readout: Units of measure shall be shown on the indicating and totalizing dials of all meters, gauges and other measuring devices.

2.07 PROTECTION AGAINST ELECTROLYSIS

A. Where dissimilar metals are used in conjunction with each other, suitable insulation shall be provided between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. The insulation shall be bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers or other approved materials. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings or bushings.

2.08 SPECIAL TOOLS

A. For each type of equipment to be furnished by the Contractor, the Contractor shall provide a complete set of all special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation and maintenance of such equipment.

2.09 PAINTING

A. Conform to applicable requirements of Section 09900, and following requirements unless modified or superseded under other Sections.

B. Factory Painting: On pumps, motors, drives, starters, control panels and other similar self-contained or enclosed components, apply a factory primer and high-quality oil-resistant baked industrial enamel finish. Paint or otherwise protect surfaces that are inaccessible after assembly by a method which provides protection for the life of the equipment.

C. Shop Priming: Apply one or more shop coats of metal primer on surfaces to be finish painted at the site, of sufficient thickness to protect surfaces until finished. Use primers specified for the required paint systems in Section 09900, PAINTING AND COATING.

D. Rust Preventive: Coat machined, polished, other ferrous surfaces, and non-ferrous surfaces which are not to be painted with rust preventive compound, Dearborn Chemical No-Ox-Id 2W; Houghton Rust Veto 344; Rust-Oleum 4-9; or equal.

2.10 NOISE AND VIBRATION

A. Mechanical and electrical equipment, as installed in this project, shall not create sound levels that are in excess of that permitted by CAL/OSHA for 8 hours per day worker exposure unless otherwise noted for the specific piece of equipment involved.

B. If the required sound level cannot be achieved by bare equipment in its designated environment, sound attenuating enclosures shall be provided. Sound attenuating enclosures shall have necessary ventilation to prevent equipment overheating and shall be constructed for easy removal to permit maintenance. Devices necessary for day-to-day operation shall pierce the enclosure or otherwise be accessible without need to remove the enclosure. Vibration of rotating mechanized equipment shall not exceed 2 mils peak to peak at any point on the casting over the full range of operation. Vibration will be measured by the Engineer.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect each item of equipment for damage, defects, completeness, and correct operation before installing. Inspect previously installed related work and verify that it is ready for installation of equipment.

3.02 PREPARATION

A. Prior to installing equipment, ensure that the areas are clean and that concrete or masonry operations are completed. Maintain the areas in a broom-clean condition during installation operations. Clean, condition, and service equipment in accordance with the approved Instruction Manuals and specific requirements included in applicable Sections.

3.03 MANUFACTURER'S SUPERVISION AND AFFIDAVIT

A. Each equipment manufacturer shall furnish the services of an authorized representative especially trained and experienced services as required and to obtain the information for the manufacturers affidavits specified in the Special Conditions and subsequent specifications: (1) supervise the equipment installation in accordance with the approved Instruction Manual, (2) be present when the equipment is first put into operation, (3) inspect, check, adjust as necessary, and approve the installation, (4) repeat the inspection, checking, and adjusting until all trouble or defects are corrected and the equipment installation and operation are acceptable, (5) witness and supervise operational demonstrations and system validation tests to the extent specified, and (6) prepare and submit the specified Manufacturer's Affidavit. Include all costs for representative's service in the Contract Price.

3.04 INSTALLATION

A. Structural Fabrications: Conform to the AISC Code and Specifications referenced in Article "Structural Steel Fabrications."

B. Equipment: Conform to approved Instruction Manuals. Employ skilled craftsmen experienced in installation of the types of equipment specified. Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce acceptable installations free of vibration or other defects. Align and pin to common bedplate equipment and drivers connected by flexible couplings.

C. Anchor Bolts: Deliver bolts with templates or setting drawings and verify that bolts are correctly located before structural concrete is placed.

D. Base and Bedplate Grouting:

1. Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Bevel exposed grout at 45 degree angle, except round exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth, dense finish and damp cure with burlap for three days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform approved corrective work as required to conform to the tolerances given in the applicable Instruction Manual.

2. The Contractor shall make an allowance of at least 1 ½ -inches for grout under the equipment bases, whether or not shown on the Drawings. Shims used to level and adjust the bases shall be steel. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise approved, all grout shall be an approved non-shrink, non-metallic grout.

3. The grout shall be dimensionally stable, inorganic, premixed and resistant to acids, alkalies, salt water, and shall be unaffected by water and oil. It shall have high strength even when used as a pourable mixture, and shall bond well with steel and cured concrete or be compatible with a suitable bonding agent which shall then be used to affect the bond. It shall be used in strict accordance with the manufacturer's recommendations. It shall be Five Star Grout as manufactured by U. S. Grout Corporation; Bonsai Construction Grout as manufactured by Bonsal Co.; or equal. It shall be submitted to and favorably reviewed by the Engineer prior to use.

4. Where practicable, the grout shall be placed through the grout holes in the equipment base and worked outward and under the edges of the base and across the rough top of the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

END OF SECTION

SECTION 11050

EQUIPMENT MOUNTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Equipment mounting requirements, including fabricated steel equipment bases, concrete equipment pads, supports, anchorage, and accessories.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01330 – Submittals
2. Section 05501 – Anchor Bolts and Anchoring Devices
3. Section 09900 – Coating System

1.03 QUALITY ASSURANCE

A. Provide supports, anchorage, and equipment mounts that are sized and designed to resist the calculated forces and that are in accordance with the manufacturer's recommendations, the California Building Code (CBC), and industry standards requirements.

1.04 DESIGN REQUIREMENTS

A. Design equipment mounts and anchorages to resist the minimum lateral force required by the latest edition of the CBC, the manufacturer of the equipment, or a lateral seismic force of 60 percent of the operating weight of the equipment, whichever is greater.

B. Equipment anchor bolt sizes shown on the Plans are the minimum required size.

C. Equipment anchorage design and calculations shall be prepared and signed by a civil or structural engineer currently registered in the state where equipment is installed.

1.05 MOUNTING REQUIREMENTS

A. Mount equipment and driver on a common fabricated steel baseplate with ample rigidity to support equipment and maintain shaft alignment without excessive deflection.

B. Mount equipment baseplates on concrete equipment pads.

1.06 SUBMITTALS

A. Prepare and submit in accordance with Section 01330.

B. Shop Drawings: Provide drawings of equipment bases and anchorage details.

C. Anchorage Calculations: Submit stamped and signed anchor bolt sizing calculations.

PART 2 - PRODUCTS

2.01 ANCHOR BOLTS AND CONCRETE ANCHORS

A. Provide anchor bolts and concrete anchors in accordance with Section 05501.

2.02 CONCRETE EQUIPMENT PADS

A. Construct concrete pedestals at least 6 inches wider and longer than the steel or cast base so that the distance between the anchor bolts and the edge of concrete is at least 3 inches. Anchor bolt edge distance shall be considered in the preparation of the Anchorage Calculations.

B. Unless otherwise shown or specified, all conduits, piping connections, drains, etc. shall be enclosed by the concrete base.

C. Shape concrete pedestals to drain away from the base.

D. Allow concrete to cure 14 days or until the concrete has cured to 75 percent of its specified compressive strength before placing equipment on the concrete pedestal.

E. Do not start equipment placed on the concrete pedestal until the concrete has cured for 28 days or to 100 percent of its specified compressive strength.

2.03 STRUCTURAL STEEL EQUIPMENT BASES

A. Provide structural steel bases with thickened steel pads for doweling.

1. Fabricate equipment base using continuous welds to seal seams and contact edges between steel members.

2. Grind welds smooth.

B. Design equipment bases with perimeter steel beams, intermediate stiffeners and baseplate.

1. Provide perimeter steel beams with minimum depth equal to 1/10th of the longest dimension of the base.

2. Beam depth need not exceed 14 inches provided that the baseplate deflection is kept within acceptable limits to minimize misalignment, as determined by the manufacturer.

C. Provide grout holes for the bases of equipment where vibration isolation is not specified.

D. Provide minimum 1-inch thick steel mounting baseplate for equipment with drivers 20 horsepower and larger.

E. Shop-apply prime coat prepared in accordance with the requirements of Section 09900 and compatible with the finish coatings

PART 3 - EXECUTION

3.01 GENERAL

A. Connect piping to equipment with flexible connections and/or expansion joints such that the intended use of these joints is maintained in the piping system.

B. Coordinate the location of electrical conduit and piping penetrations within the concrete pad and equipment base.

1. Stub-up penetrations on the same side of the equipment as required for connection to the equipment.

2. Locate equipment drains for proper drainage away from equipment.

3.02 EQUIPMENT MOUNTING

A. Mount equipment on equipment baseplates using stainless steel shims so that equipment and driver are level in both directions and mounted within machined areas on baseplate. Do not use wedges to obtain level and alignment.

B. Utilize templates for placement of anchor bolts prior to placing concrete for equipment pad.

C. Apply a non-seize or non-galling compound on the threads of anchor bolts and concrete anchors.

3.03 SHAFT ALIGNMENT

A. After the complete unit has been installed on the equipment pad and leveled, check the factory shaft alignment by disassembling coupling and measuring angular and parallel orientations.

B. Use reverse-indicator dial or laser type alignment equipment to align shafts to within the manufacturer's required tolerance. Allow for thermal expansion, spacer coupling length and other factors that affect proper shaft alignment.

3.04 GROUTING EQUIPMENT BASES

A. After alignment has been completed, tighten anchor bolts and grout between equipment base and equipment pad. Use non-shrink and non-ferrous grout no less than 7/8-inch and no more than 1 5/8 inches thick.

B. Allow 48 hours for grout to harden and then remove jacking screws. Re-check torque on anchor bolts and re-check shaft alignment, making corrections as necessary.

END OF SECTION

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SECTION 11260

GASEOUS CHLORINE FEED SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Section Includes:

1. Provide complete gaseous chlorine feed and injection systems as shown on the Drawings and as specified herein, utilizing liquefied compressed chlorine gas and carrier water for the treatment of water for potable use. Gaseous chlorine feed and injection systems shall be designed to be compatible for drawing chlorine from the chlorine gas container containment system as specified in Section 11261, Chlorine Gas Container Containment System, and as shown on the Drawings.

2. Provide the services of manufacturers' engineering representatives for construction support necessary to ensure that the Owner receives completely integrated and operational gaseous chlorine feed and injection systems. Services shall include supervising startup testing, field pump calibration, O & M manuals, and operator training.

3. Related Sections:

a. Section 11001: General Equipment and Mechanical

b. Section 11261: Chlorine Gas Container Containment System

1.02 REFERENCE STANDARDS

A. Chlorine Institute

B. Compressed Gas Association

C. ANSI – American National Standards Institute

D. OSHA – Occupational Safety and Health Administration

E. ASTM – American Society for Testing and Materials

F. NEMA – National Electrical Manufacturing Association

1.03 CHEMICAL INJECTION SYSTEM INTEGRATOR REQUIREMENTS

A. It is required that the Contractor supply a single gaseous chlorine feed and injection system integrator to furnish all of the equipment specified herein to ensure coordination in design, fabrication, start-up and testing.

B. The gaseous chlorine feed and injection system integrator shall be responsible for all documentation including submittals, O&M Manuals, and as-built documentation, and shall be responsible for start up and resolution of any warranty issues for all equipment supplied.

1.04 CHEMICAL INJECTION SYSTEM INTEGRATOR RESPONSIBILITIES

A. General: The equipment as specified in this section shall be considered an integrated system. Entire system installation, including calibration, verification,

startup, operation testing, and training, shall be performed by qualified personnel, possessing all the necessary skills and equipment, and who have had experience performing similar installations. Gaseous chlorine feed and injection systems shall be compatible for drawing chlorine from the chlorine gas container containment system as specified in Section 11261, Chlorine Gas Container Containment System, and as shown on the Drawings.

B. Process piping system drawings are shown on the Drawings; however, it is the responsibility of the gaseous chlorine feed and injection system integrator to determine performance requirements, and coordinate the selection of specified equipment with Contractor to meet the design conditions. Gaseous chlorine feed and injection system integrator shall select process piping accessories for the proper material compatibility and operation of the system including corrosion valves, tubing, fittings, and appurtenances.

1. Compatibility: Select materials for this system that are compatible for use with the physical and chemical properties of gaseous chlorine. Provide such additional equipment, accessories, etc., as are necessary to meet these objectives at no cost to the Owner.

2. Coordination: Provide technical advice to mechanical and electrical subcontractors as necessary regarding their installation of instruments.

a. Adjust, startup, and test all gaseous chlorine feed and injection equipment.

b. Provide specified documentation and training.

3. Performance: While the Drawings provide sufficient information to establish the form and function of the systems and their relationships, the responsibility for system integration and performance rests solely with the Contractor. The Resident Engineer provides technical instruction and guidance where needed.

4. The gaseous chlorine feed and injection system integrator shall have a factory-trained service representative located in Northern California with in-house capability of servicing, repairing, and overhauling the equipment specified in this section. This service representative shall maintain a supply of spare parts for the equipment.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Section 01330 – Submittals. Refer to this section for required method of preparation and transmittal, and conform to requirements herein.

1. Shop Drawings:

a. Submit shop drawings (diagrams) for review in complete bound sets.

b. Submit manufacturer's catalog cuts for each item, clearly marked to delineate the options or styles to be furnished.

2. Record Drawings:

a. Submit a revised set of shop drawings that incorporates all change orders and modifications made during performance of the work.

b. Submit a copy of CAD produced drawings on magnetic or optical media in AutoCAD DWG Version 2000 or later format

3. Operation and Maintenance Manuals: Furnish Operation and Maintenance Manuals, including Installation and Instruction Manuals and Part Lists, for all equipment furnished for this contract.

a. Schedule: Deliver at least four (4) copies of O & M manuals in 3-ring binders (8-1/2 by 11-inch format) not later than the equipment shipment date.

b. Contents: Include in manuals not less than the following information, as applicable:

1) Installation instructions, tolerances, and precautions.

2) Maintenance, calibration, and repair instructions.

3) Parts list and spare parts recommendations.

4) Calibration curves, rating tables, and any other data showing the relationship of the variable inputs and the calibrated output of all measuring devices and controls.

c. Special Tools and Accessories: Furnish any special tools, instruments, and accessories for maintaining equipment.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Enclose and protect equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage.

PART 2 - PRODUCTS

2.01 GAS CHLORINATORS

A. Gas Chlorinators shall be vacuum-operated, solution feed type, designed for mounting directly on a chlorine cylinder.

B. Chlorinators shall have the following minimum capacities at maximum output:

Equipment Location	Injection Location	Dosage Capacity (1) (lbs per day Cl2 gas)
Control Building Chlorine Room Chlorine Feed Panel No. 1	Post Well No. 1	68
Control Building Chlorine Room Chlorine Feed Panel No. 2	Post Well No. 2 (Future – not in Contract)	53 (Future – not in Contract)
Control Building Chlorine Room Chlorine Feed Panel No. 3	Treated Water Pump Station	68
(1) Minimum capacity of Chlorinator's maximum capable output.		

C. Each chlorinator shall be a vacuum operated solution feed type and mount directly on the chlorine containment vessel outlet valve by means of a corrosion resistant positive yoke type clamp having an integral tightening screw with slide-bar handle. The yoke clamp shall be designed and constructed to meet the requirements of the Chlorine Institute, and shall be for use with CGA Connection 820 or 820C.

D. All regulating, metering, flow adjusting and safety functions shall be incorporated in the cylinder mounted chlorinator unit. The chlorine flow rate is manually adjusted and is regulated by a spring opposed diaphragm regulator which also contains the safety shut-off valve.

E. Manufacturers, or equal:

1. Chlorinators Incorporated, Regal, Model 210
2. Hydro Instruments, 500 Series

2.02 SAFETY SHUTOFF

A. Electro-pneumatically activated automatic safety shutoff actuators for the chlorine feed systems to automatically close the supply valves. Actuators shall close the supply valves upon solenoid de-energization or power loss, or inadequate or loss of pneumatic actuation pressure. Actuators shall be provided with the chlorine gas container containment system supplier as specified in Section 11261, Chlorine Gas Container Containment System, and as shown on the Drawings.

2.03 AUTOMATIC CHANGEOVER SWITCH

A. Automatic changeover switch shall consist of a vacuum actuated three-way-valve consisting of two vacuum gas line inlets, and one vacuum gas outlet. Switch shall be sized for handling the dosage capacities as listing herein. The switch construction shall be suitable for chlorine gas and shall include the following components:

1. Main Body
2. End Bodies and Top Cap
3. Toggle Assembly with spring loaded pin, pivot pin, sliding shaft, and shaft o-ring seals
4. Internal diaphragms, with threaded clamping nuts
5. Tube fittings
6. Assembly bolts
7. Wall mounting bracket
8. Status contact for remote status indication

B. The switch shall be easily disassembled to allow serviceability of all internal moving parts, wear parts, and seals.

C. Manufacturers, or equal:

1. Grundfos Vaccuperm
2. Wallace & Tiernan Series 55-400

2.04 ROTAMETER

A. Rotameter shall consist of a borosilicate glass tube and a Hastelloy-C or black glass float. Glass body shall contain custom graduation marks to indicate flow rates of the following ranges in pounds per day:

Equipment Location	Flow Range (lbs per day Cl2 gas)
Control Building Chlorine Room Chlorine Feed Panel No. 1	0-100
Control Building Chlorine Room Chlorine Feed Panel No. 2	0-100 (Future – not in Contract)
Control Building Chlorine Room Chlorine Feed Panel No. 3	0-100

B. Manufacturers, or equal:

1. King Instrument, 7430 Series

2.05 GAS FEED CONTROL VALVE

A. An automatic control valve shall be provided for Chlorine Feed Panel No. 1 and Chlorine Feed Panel No. 3 to control gas feed at the rates required as stated in this Section.

B. Each automatic control valve shall be comprised of a controller and variable area orifice rate valve. These devices shall be incorporated into one compact unit. The microprocessor based automatic control valve shall adjust the gas feed rate based on one electronic input signal. The automatic control valve shall allow for the following standard, field selectable control modes:

1. Manual

2. Proportional control (Flow)

C. Motion of the valve shall be achieved by means of a linear stepper motor. Motion control shall be achieved without the use of a feedback potentiometer. To ensure accurate feed rates throughout the range of operation, the software shall incorporate a 10-point valve linearization calibration. The length of the variable area orifice portion of the rate valve stem shall be no less than 1.5 inches for accurate feed rate control.

D. The automatic valve shall be housed in a NEMA4X rated enclosure. Power shall be available in either 120-VAC or 240-VAC.

E. User interface of the automatic control valve shall include an LCD display, with a front panel button keypad. Control parameters shall be password protected and adjustable through the keypad while displayed on the screen. The controller shall include the following inputs and outputs:

1. The automatic control valve shall include one analog input channel.

2. The analog input signal shall be 4-20mA.

3. The input channel shall be used only for a proportional (flow) input signal.

4. A common relay output shall be provided for remote indication of alarm conditions.

5. Two 4-20 mA output signals, representative of valve position, shall be provided.

F. Manufacturers, or equal:

1. Hydro Instruments, Series 230 (wall panel series at the Contractor's option)

2. Chlorinators Incorporated, Regal Series 7000 Smartvalve

3. Chemical Injection Technologies, Superior Series 2000 Autovalve

2.06 EDUCTOR (EJECTOR)

A. One ejector for each gaseous chlorine feed and injection system shall be provided. Ejectors shall be water operated venturi nozzle type. The ejector shall provide the operating vacuum for the chlorination system.

B. The ejector shall incorporate a spring loaded, normally closed check valve to prevent the backflow of water into the chlorine gas equipment. The check valve shall be suitable for back pressures up to a minimum of 140 psi. The check valve shall be of positive, tight shut-off. The check valve shall be suitable for back pressures up to a minimum of 140 psi, and shall automatically close upon the loss of vacuum in the ejector.

C. Manufacturers, or equal:

1. Hydro Instruments

2.07 CHEMICAL INJECTOR:

A. Chemical Injector to inject and disperse the chlorine solution into the process pipeline as detailed on the Drawings.

1. Injector: Provide Injector to inject and disperse the chlorine solution into the process as detailed.

a. For pipeline application.

b. Stub type extending into the process pipeline per drawings. 1-1/2 inch NPT corporation stop, 1 inch NPT inlet connection.

c. Rigid pipe material, corrosion resistive and suitable for chlorine application.

d. Include an oversized corporation cock or ball valve attached to the pipe with a tee fitting or a saddle and pressure packing to allow tube withdrawal under pressure in the process pipe as shown on the Drawings.

e. Tube diameter size: 1 inch.

B. Manufacturers, or equal:

1. Saf-T-Flow, model EB-159-B-S-4-0-ASSY

2.08 WEIGH SCALES

A. Weigh scales for the one-ton containers shall be provided with the chlorine gas container containment system supplier as specified in Section 11261, Chlorine Gas Container Containment System.

2.09 BOOSTER PUMPS

A. Provide multi-stage pressure booster pumps rated for continuous duty, and designed for use with clear water containing no abrasives. Multi-stage pressure booster pumps shall be provided according to the following schedule:

ID No.	Equipment Location	Minimum Pump Capacity	Nominal Horsepower
P601	Control Building Chlorine Room Chlorine Feed Panel No. 1	4.8 gpm @ 60 psi	1/3
P602	Control Building Chlorine Room Chlorine Feed Panel No. 2	6.0 gpm @ 80 psi (Future – not in Contract)	3/4 (Future – not in Contract)
P603	Control Building Chlorine Room Chlorine Feed Panel No. 3	8.5 gpm @ 110 psi	1

B. Pump motors shall be in ODP or TEFC enclosures, equipped with permanently lubricated ball bearings, capacitor start, capacitor run, thermal overload protection. Motors shall be provided with the pump and rated for continuous duty, suitable for 230-VAC, single phase wiring. Pump impellers and diffusers shall be of noryl, with polyacetal diffuser plates. Pump shafts shall be of type 430 stainless steel. Pump shaft couplings and shells shall be of type 304 or 316 stainless steel. Discharge and suction casings shall be of cast iron. O-rings shall be of Buna-N or Viton. Shaft seals shall be of carbon against ceramic or silicon carbide, with type 304 stainless steel springs and Buna-N or Viton seals.

C. Provide powder coated cast iron or fabricated steel, or stainless steel base mount, and stainless steel mounting hardware as required, or provide stainless steel unistruts and stainless steel hardware as required for mounting each pump above the floor.

D. Manufacturers, or equal:

1. Dayton, 5NXZ Series

2.10 MISCELLANEOUS VALVES AND PIPING

A. Rigid piping shall be ASTM A106 Grade B Schedule 80 seamless carbon steel piping when the process temperature range is -20°F to 300°F (-29°C to 149°C). Threaded or socket-welded construction can be used for pipe diameters of 1½ inches or less. Butt-welded and flanged joints can be used for all sizes of piping.

B. Flexible piping and tubing shall be annealed copper tubing suitable for brazing. ASTM Specification B-88 is recommended provided the material furnished is of the proper dimensions. Alternative manufactured nonmetallic and metallic hoses are acceptable pending they are certified for use with gaseous chlorine for the intended service.

C. Fittings, flanges, valves, nuts, bolts, flexible connectors, pipe dope and other fittings used wherever piping may be under pressure must be as per Chlorine Institute, Pamphlet 6, and manufacturer certified for chlorine use for the intended service. Acceptable gasket materials shall be per Chlorine Institute, Pamphlet 95.

D. Refer to Chlorine Institute, Pamphlet 164 for additional materials compatibility information.

E. Piping systems must be thoroughly cleaned and dried before use per Chlorine Institute, Pamphlet 6.

2.11 SPARE PARTS

A. Provide new spare parts per manufacturer recommendation in the original packaging for future maintenance requirements. Deliver all spare parts to Owner when the operational startup testing is conducted.

B. Group related parts together in an organized manner. Provide a "Bill of Material" type inventory transmittal form.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Provide equipment and materials suitable for the installation locations.

1. All equipment specified for field mounting shall be weatherproof and splash proof as a minimum.

2. If electrical or electronic components are contained within the equipment, they shall be housed in NEMA 4X in corrosive locations unless noted otherwise on the Drawings.

B. Equipment Supports:

1. Supports installed within the Chlorine Room shall be Type 304 stainless steel Unistrut, fiberglass channel by Aikenstrut Unistrut, or approved equal.

C. Fasteners:

1. Fasteners for securing equipment to walls, floors and the like shall be stainless steel. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields, unless noted otherwise. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8 inch.

3.02 PREPARATION

A. Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing instruments and equipment. Maintain the areas in a broom-clean condition during installation operations.

B. Panels shall be protected during construction to prevent damage to front panel devices and prevent dust accumulation.

3.03 FIELD TESTING

A. Notify the Resident Engineer and Owner in writing a minimum of 1 week prior to the proposed date for commencing final operational testing and acceptance.

B. Final Operational Testing: Upon completion of instrument verification, test all systems under process conditions in the presence of the Owner or designated representative. System testing shall be accomplished in accordance with the approved Test Plan. The test for each portion thereof shall be witnessed, documented and signed off upon completion by the Resident Engineer.

3.04 INSTRUCTION OF OWNER'S PERSONNEL

A. Provide the services of a factory trained and field experienced manufacturer’s representative to conduct group training up to ten of the Agency's designated personnel in the operation of the system. This training shall be for the time period of 4 hours. Include instruction covering operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the Operation and Maintenance Manuals furnished under these Specifications.

END OF SECTION

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SECTION 11261

CHLORINE GAS CONTAINER CONTAINMENT SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Provide chlorine gas container containment equipment as a complete functioning system as shown on the Drawings and as specified herein.

B. Provide the services of manufacturers' engineering representatives for construction support necessary to ensure that the Owner receives a completely integrated and operational chlorine gas container containment system. Services shall include supervising startup testing, field adjustments, O & M manuals, and operator training.

C. Drawings show functional features and required external connections. The Drawings may not show all components required to accomplish the desired results or all components required to interface with the equipment. All parts, equipment, and devices necessary to meet the functional requirements shall be provided.

D. Drawings show a general arrangement of chlorine gas container containment equipment, connected piping and valves. Drawings are not intended to show exact dimensions peculiar to any specific chlorine gas container containment equipment. Dimensions of the equipment, equipment bases and connected piping shown, may have to be revised in order to accommodate the chlorine gas container containment system provided. The Contractor shall coordinate with the manufacturer of the Chlorine gas container containment system equipment for the proper location of the system.

E. All equipment provided under this Section shall be furnished by a single supplier or manufacturer who shall assume full responsibility for the completeness of the system. The single supplier or manufacturer shall guarantee and be the source of information on all equipment regardless of the manufacturing source of that equipment.

1.02 REFERENCED SECTIONS

A. The following Sections are reference din this Section

1. Section 01330 – Submittals
2. Section 03600 – Grout
3. Section 05501 – Anchor Bolts
4. Section 09900 – Coating System
5. Section 11260 – Gaseous Chlorine Feed System

1.03 REFERENCE STANDARDS

A. Chlorine Institute

B. Compressed Gas Association

C. ANSI – American National Standards Institute

D. OSHA – Occupational Safety and Health Administration

E. ASME – American Society of Mechanical Engineers

F. ASTM – American Society for Testing and Materials

G. NEMA – National Electrical Manufacturing Association

1.04 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Equipment shall be the standard product in regular production by manufacturers of Chlorine gas container containment equipment and shall essentially duplicate equipment that has been in satisfactory operation at least five (5) installations for a period of at least five (5) years.

B. Source Quality Control: The manufacturer shall use only equipment, which is compatible in function, arrangement, reliability and accuracy and will perform in the modes of operation outlined herein. The Contractor shall require all equipment listed in this Specification to be furnished or coordinated through a single Chlorine gas container containment equipment manufacturer. The manufacturer shall furnish equipment for which the controls shall meet the requirements as specified herein.

C. Comply with applicable provisions and recommendations of the following:

1. Welding shall be in accordance with ASME Code Section IX using any of the following welding procedures:

   a. SMAW P1-B1.

   b. GTAW/SMAW P1-42-1A.

   c. SMAW/SAW P1-1A.

   d. GTAW P1-1A.

   e. FCAW P1-1 ¾ (for non-pressure welds only).

2. All completed welds shall be visually inspected.

3. Spot radiograph welds per UW-52 of ASME Code Section VIII, Div I. One increment of weld shall include a junction.

4. After fabrication, but prior to application of coatings, each tank shall be hydrostatically tested in accordance with ASME Code. Tanks shall be hydrostatically tested at the factory to 375 psig per UG99.

5. Fabrications shall be in accordance with ASME Code Section VIII, Div. I.

6. Design pressure shall be equal to 250 psig at 300 degrees Fahrenheit; minimum design metal pressure (MDMT) equals –20 degrees Fahrenheit at 250 psig; 1/16" corrosion allowance provided; service chlorine containment.

7. Nameplates and Code Stamps: Each containment vessel shall bear a stainless steel ASME nameplate. Each nameplate shall bear the applicable code symbol. Manufacturer shall be authorized by ASME to apply the applicable code symbols.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Section 01330. Refer to this section for required method of preparation and transmittal, and conform to requirements herein.

1. Shop Drawings:

   a. Submit shop drawings (diagrams) for review in complete bound sets.

   b. Shop drawings shall show the layout and dimensional data of all equipment furnished, fabrication assembly, and the configuration. The layouts and dimensions given on the Drawings are a guide only and may be modified to suit the equipment furnished. Drawings shall include containment vessel dimensions, wall thickness, mounting, and anchorage requirements.

   c. Submit manufacturer's catalog cuts for each item, clearly marked to delineate the options or styles to be furnished.

   d. Submit data on capacity, weight, and material, and coating of each item of equipment.

   e. Submit detailed drawings or manufacturer’s literature to indicate compliance with specified requirements.

   f. Submit certification and ASME code data reports in accordance with ASME code and, as applicable, 49 CFR 178.337 or other similar codes. The certification shall include certification of hydrostatic testing. Equipment shall not be shipped until vessel has passed hydrostatic testing.

   g. Provide documentation that the manufacturer has produced, supplied and placed into satisfactory service, equipment similar to that specified herein. Criteria shall be a minimum of five (5) installations in service for a minimum of five (5) years.

   h. No equipment shall be shipped until the Shop Drawings are approved.

2. Record Drawings:

   a. Submit a revised set of shop drawings that incorporates all change orders and modifications made during performance of the work.

   b. Submit a copy of CAD produced drawings on magnetic or optical media in AutoCAD DWG Version 2000 or later format.

3. Operation and Maintenance Manuals: Furnish Operation and Maintenance Manuals, including Installation and Instruction Manuals and Part Lists, for all equipment furnished for this contract.

   a. Schedule: Deliver at least four (4) copies of O & M manuals in 3-ring binders (8-1/2 by 11-inch format) not later than the equipment shipment date.

   b. Contents: Include in manuals not less than the following information, as applicable:

      1) Installation instructions, tolerances, and precautions.

      2) Maintenance, calibration, and repair instructions.

3) Parts list and spare parts recommendations.

4) Calibration curves, rating tables, and any other data showing the relationship of the variable inputs and the calibrated output of all measuring devices and controls.

c. Special Tools and Accessories: Furnish any special tools, instruments, lubricants, and accessories for maintaining equipment.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall comply with the manufacturer's recommendations in handling and storing equipment. Store all equipment to permit easy access for inspection and identification.

B. Enclose and protect equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage.

C. If the Engineer or Owner determines that damaged equipment can be repaired at the site, all repairs shall be made by the manufacturer or in accordance with the manufacturer's instructions and under his supervision. Repairs made shall be subject to the approval of the Engineer or Owner at the Contractor's expense.

D. Damaged equipment, rejected by the Owner, shall be removed from the site by the Contractor.

PART 2 - PRODUCTS

2.01 GENERAL

A. The chlorine gas container containment system consists of two steel containment vessels, each for containing a single one-ton chlorine gas container. The gas container is sealed within the containment system using a Viton lip seal, tool-less door. The containment vessel includes a fail-safe valve that is operated by nitrogen gas and electrical power, nitrogen gas supply to fail-safe actuator, vessel weighing system with electronic weight indication, rollers (in vessel interior), pressure relief valve, vacuum/pressure gauge, interior chlorine supply flex hose, halogenated lubricant, pivots, valves, piping and fittings, container loading system, and manufacturer's on-site consultation and training services.

B. All components shall be selected for safe reliable operation. Components, and the system as a whole, shall conform to the suggested requirements of The Chlorine Institute.

C. All components exposed to chlorine liquid, chlorine solution, or chlorine gas shall be entirely suitable for the service.

D. All electronic components, panels and switches in the chlorinator room shall be encapsulated or otherwise protected by NEMA 4 enclosures.

2.02 CHLORINE GAS CONTAINER CONTAINMENT SYSTEM AND CONTAINER LOADER SYSTEM

A. General Description:

1. Each container containment system shall consist of a 40-inch diameter containment vessel for a single one-ton chlorine container.

2. The chlorine gas containment system shall be designed to operate with a vacuum-operated solution feed system as specified in Section 11260.

3. Each containment vessel shall include a nitrogen gas/electrically operated fail-safe valve, nitrogen gas supply and fail safe actuator, 120 VAC electrical connection to fail safe actuator, interior vessel rollers, pressure relief valve, vacuum/pressure gauge, pressure supply flex hose (interior), valves, piping and fitting accessories, weighing system, and manufacturers on-site consultation services.

4. A container loading system shall be provided.

B. Manufacturer, or equal: Chlorine Gas Containment Container System and Container Loader System shall be provided by TGO Technologies.

C. Containment Vessel:

1. A single one-ton chlorine gas container containment system vessel shall be of carbon steel construction with design pressure equal to 250 psig at 300 degrees Fahrenheit. Vessel fabrication shall be fabricated in accordance with ASME Code Section VIII, Div. I.

2. Each containment vessel shall bear a stainless steel ASME nameplate. Each nameplate shall bear the applicable code symbol. Vessel manufacturer shall be authorized by ASME to apply applicable code symbols.

3. All vessel welding shall be in accordance with ASME Code Section IX using any of the following welding procedures: SMAW P1-B1, GTAW/SMAW P1-42-1A, SMAW/SAW P1-1A, GTAW P1-1A, FCAW P1-1 ¾ (for non-pressure welds only). All welds shall be visually inspected.

4. Each containment vessel shall be tested in accordance with ASME after fabrication and prior to coating. Completed vessels shall be hydrostatically tested to 375 psig at the factory per UG99.

5. Coat machined surfaces with rust preventative compound. Each containment vessel interior shall be sandblasted to SSPC-SP-10 and then coated to 2.5 to 3.0 Mils DFT with Carbonzinc 11 HS (inorganic zinc primer). The vessel exterior shall also be blast cleaned to SSPC-SP-6, then prime coated to 4 to 6 Mils DFT with 385 Epoxy (Red), or equal. Finish coat exterior with Devoe Coatings Devthane 379 Polyurethane, or equal to 2 Mils DFT, Color: BL-6 (OSHA Safety Blue).

6. Vessel door design shall be chain driven horizontal double bolt door design closure with hand crank or hand wheel. Door O-ring shall be provided. O-ring material shall be Viton.

7. Container holding bay within vessel shall be provided with interior rollers, Force Flow Model 21L Roller Trunnions or equal.

8. Mount bosset connections into interior of vessel. Bosset locations are provided for one primary chlorine gas draw point and one alternative chlorine gas draw point. Provide ton container valve for each bosset connection. Ton valves shall be Sherwood Type 1214 X1-B1-ton container

valves, or equal. Body material shall be Aluminum Silicon Bronze Alloy B, and the stem material shall be Monel.

9. Provide two threaded elbow-coupling manual connections welded into interior of vessel. One connection shall be provided for pressure check and other connector shall be provided for vacuum/pressure gauge. Provide a ton container valve for each elbow coupling connection. Ton valves shall be Sherwood Type 1214 X1-B1-ton container valves, or equal. Body material shall be Aluminum Silicon Bronze Alloy B, and the stem material shall be Monel.

10. Provide coupling connection into interior of vessel for pressure relief valve.

11. Provide necessary fittings compatible with Chlorine service to accomplish connection of valves, switches and gauges to containment vessel.

D. Vessel Interior Chlorine Transfer Hoses:

1. Provide one (1) Chlorine transfer hose within interior of each containment vessel. Transfer hose shall be corrugated Monel 400 with stainless steel guard cover.

2. Each transfer hose shall be gas pressure tested at a minimum of 750 psig.

3. Each transfer hose shall be ¼ in. I.D. x 38 in. in length with ¼ in. MNPT ends.

4. Provide one roll of Teflon tape, Yoke Adaptor #5888-D-1/2-1/4 NPT, Yoke Assembly #U1953 ASSY 628, ¼ x ¼ in.-3000 lb. threaded 90 degree Monel 400 elbow for each transfer hose.

E. Vessel Pressure Relief Valve:

1. Provide one pressure relief valve per containment vessel. Valve shall be connected to containment vessel interior.

2. Valve size shall be 3/4 inch MNPT inlet, 1 inch FNPT outlet.

3. Materials for valve shall be Teflon Seat, Carbon Steel Container, Monel Base, Monel Disc, Monel Insert, Monel Disc Holder, Monel Guide, and Inconel X750 Steel spring.

4. Valve shall be Crosby 900 Omni Trim Valve Model No. 951631 MA Inconel X750 Spring or equal. Set to 225 psig.

F. Vessel Vacuum/Pressure Gauge:

1. Pressure/vacuum gauge and diaphragm shall be Ashcroft, 3.5 inch dial, 30 inch vacuum, 100 psi pressure range, diaphragm protected (Viton), ¼ inch threaded with Monel 400 nipple, gauge type #35-1009AW-02L-30/100 or equal, diaphragm type W/25-310UH-02T or equal, Halocarbon fill. Provide appropriate connectors to connection of gauge to vessel interior elbow connector.

G. Container Loading System:

1. Provide one framed, permanently mounted, roller/conveyor type gas container loader system. Loader system shall be designed to be compatible with the installed containment vessel arrangement in the approximate location shown on the Drawings, and shall not hinder routine container

loading and unloading, equipment inspection and monitoring, and routine maintenance activities. Loader system shall be manufactured by TGO Technologies, or equal.

H. Fail-Safe Actuator and Valve Systems:

1. Fail-Safe actuator and valve system shall consist of an electro-pneumatic actuated ball valve with nitrogen supply system. One fail-safe actuator and valve system shall be provided for each containment vessel. One backup manually operated valve system shall be provided for each containment vessel.

2. Fail-safe valve shall only be open upon energization of the normally closed solenoid actuated pneumatic valve. Electro-pneumatic actuator shall automatically close the ball valve upon solenoid de-energization or power loss, or inadequate or loss of pneumatic actuation pressure.

3. Each fail-safe assembly shall consist of each of the following:

   a. Actuator: Jamesbury VPVL051SR6 or equal.

   b. Limit Switch: Stonel Quartz QN33C02SRA-TGO-02 or equal.

   c. Solenoid Valve: Asco EF8320G714/120V or equal.

   d. Ball Valve: Jamesbury 4CBC-7173XTB-2 or equal, with ½ inch, Monel body, Hastalloy ball, and Teflon seats, chlorine cleaned.

4. Backup manual valve shall be ½ inch, Monel body, Hastalloy ball, Teflon seats, chlorine cleaned.

5. Nitrogen system for pneumatic operation of each fail-safe valve system shall consist of:

   a. One (1) 55 cu. ft. high pressure nitrogen gas cylinder.

   b. One (1) Harris 25-80P-580 or equal pressure regulator.

   c. One (1) pigtail assembly of ¼ inch-1500 psi, 72 inch long Teflon tube with braided stainless steel covering, with (1) safety relief valve.

2.03 CHLORINE WEIGHT SCALES

A. Features:

1. Units required: One weigh scale system sized and designed for each Chlorine gas container containment system and associated single one-ton gas container.

2. Each chlorine weighing scale system furnished shall be of such a size that it is within the dimensions of the equipment (gas container containment system and single one-ton chlorine gas container) it supports.

3. Digital readout shall be of the dual display type and shall have the capability to display net, gross, and tare values. Readout shall be equipped with a digital keyboard for easy entry of tare values.

4. The weight indicator for each scale shall be provided with a weight transmitter 4-20 mADC teed into the dial for remote signal transmission of scale contents (chlorine weight).

B. Manufacturer, or equal:

1. Force-Flow, Wizard 4000 Electronic Scale, or equal.

2.04 PAINTING

A. Unless specified elsewhere, all ferrous metal surfaces shall be blast cleaned in accordance with SSPC-SP10, shop primed and painted in accordance with the requirements of Section 09900. Pipe painting shall also be in accordance with the requirements of Section 09900. If any damage to the paint system occurs, the equipment shall be repainted as directed by the Engineer.

2.05 ANCHORAGE

A. Anchor bolts and nuts shall be of ample size and strength for the purpose intended and sized by the equipment manufacturer, using methods designed to transfer the full, ultimate strength of the anchor bolt to the concrete foundation. Refer to chlorine gas container containment system manufacturer's installation instructions for size recommendations, and Section 05501, Anchor Bolts for additional requirements.

2.06 SPARE PARTS

A. Provide new spare parts per manufacturer recommendation in the original packaging for future maintenance requirements. Deliver all spare parts to Owner when the operational startup testing is conducted.

B. Group related parts together in an organized manner. Provide a "Bill of Material" type inventory transmittal form.

C. The equipment shall be furnished with the following spare parts & special tools, which shall include a minimum of the following:

1. Two (2) Viton O-rings.
2. Two (2) chlorine transfer hoses.
3. Two (2) Yokes.
4. Two (2) Yoke adaptor.
5. Two (2) twisted chlorine wrenches.
6. Two (2) ½" valve rebuild kits.
7. Twelve (12) vessel closure locking nut gaskets.
8. One (1) 1-lb. Container 25-5S Grease.
9. Two (2) pressure/vacuum gauge 30/100.
10. Two (2) CGA fittings.
11. One (1) 55-lb Nitrogen container- filled.
12. One (1) Leak test assembly w/chlorine ton valve.
13. One (1) Harris (testing) nitrogen regulator.
14. One (1) Nitrogen Safety Relief Valve.
15. Sixteen (16) Teflon Packings.

16. One (1) Complete Failsafe.
17. One (1) 1/4 in. Drive Torque Wrench - SK Professional # SKT0400
18. One (1) 1/4 in. Drive 5/16 in. 12 pt. Socket - Westward # 5MV50
19. One (1) Combination Wrench 5/16 in. - Proto # J1210EF
20. One (1) 1/4 in. Drive 7/16 in. 12 pt. Socket - Westward # 5MV53
21. One (1) Combination Wrench 7/16 in. - Proto # J1214ASD
22. One (1) 3/4 in. Drive Torque Wrench - Westward # 10L423
23. One (1) 3/4 in. Drive 46 MM Socket - Westward # 5MX57
24. One (1) Grease Gun - Westward # 4BY69
25. Two (2) Multi-Purpose Grease - ThermaPlex # 70614
26. One (1) ½ in. Drive Torque Wrench - Proto # J6008C
27. One (1) ½ in Drive 1-1/2-in 12 pt Socket – Proto #J5448B

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation of all equipment shall be in complete accordance with the manufacturer's instructions and recommendations and the approved Shop Drawings.

B. Equipment shall be set on concrete bases, secured with anchor bolts and grouted with non-shrink grout conforming to Section 03600.

3.02 FIELD TESTING

A. Notify the Resident Engineer and Owner in writing a minimum of 1 week prior to the proposed date for commencing final operational testing and acceptance.

B. All equipment shall be operationally tested by the Contractor at the job site following installation of the equipment, controls, valves and piping. Should the tests indicate any malfunction, the Contractor shall make all necessary repairs and/or adjustments.

C. Final Operational Testing: Upon completion of instrument verification, test all systems under process conditions in the presence of the Owner or designated representative. System testing shall be accomplished in accordance with the approved Test Plan. The test for each portion thereof shall be witnessed, documented and signed off upon completion by the Resident Engineer.

3.03 INSTRUCTION OF OWNER'S PERSONNEL

A. Provide the services of a factory trained and field experienced manufacturer's representative to conduct group training up to ten of the Agency's designated personnel in the operation of the system. This training shall be for the time period of 4 hours. Include instruction covering operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the Operation and Maintenance Manuals furnished under these Specifications.

END OF SECTION

SECTION 11270

FLUORIDATION SYSTEM

GENERAL

1.01 SUMMARY

A. Provide a complete, self-contained fluoride feed system as shown on the Drawings and as specified herein, capable of continuous operation for the production of a 4% solution of liquid sodium fluoride for potable use.

B. The self-contained fluoride feed system shall consist of an upflow fluoride saturator tank, a sodium fluoride solution storage tank, a chemical metering pump, a water feed system, control panel and a secondary containment. The feed system provides equipment to safely produce the sodium fluoride solution and inject the solution into the water stream by means of a metering pump in a controlled fashion as required by the process conditions. A local control panel shall be provided to ensure proper control and operation of the system. The entire system shall be enclosed in a secondary containment structure to avoid any risk of sodium fluoride solution entering floor drains. The entire system shall consist of the following major components:

1. Upflow Fluoride Saturator Tank
2. Sodium Fluoride Solution Storage Tank
3. Sodium Fluoride Metering Pump
4. Water Feed System
5. System Control Panel
6. FRP Secondary Containment

C. Provide the services of manufacturers' engineering representatives for construction support necessary to ensure that the Owner receives a completely integrated and operational fluoridation system. Services shall include supervising startup testing, field pump calibration, O & M manuals, and operator training.

1.02 MANUFACTURER REQUIREMENTS

A. All equipment provided under this section shall be obtained from a single manufacturer, who shall:

1. Assume full responsibility for the completeness and proper operation of the fluoride upflow saturator and feed system.
2. Have experience, be reputable and qualified in designing and manufacturing packaged fluoride upflow saturator and feed system equipment of the size and type specified for a minimum of 5 years..

3. Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. The entire system shall be pre-assembled, piped, wired, factory tested and shipped as a single unit. Loose components shall not be acceptable. System footprint shall be as shown on the drawings and shall not exceed 72-inches long, by 36-inches deep, by 68-inches tall.

4. Have at least five identical self-contained fluoride upflow saturator and solution tank feed systems in operation for at least one year.

B. To ensure quality and complete unit responsibility, the complete system must be assembled and tested by the manufacturer at its facility and be a standard and regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.

C. The Engineer and Owner reserve the right to be present at the fabricator's facility for visual inspection of equipment to be supplied and to witness factory functional testing

D. Self-contained fluoride upflow saturator and feed system shall be used as manufactured and supplied by Integrity Municipal Systems, LLC, Poway, CA, (858) 486-1620. Owner and Engineer are aware of no other supplier of a complete and self-contained shop assembled fluoride upflow saturator and feed system that is an equal to this specified manufacturer and product.

1.03 WARRANTY

A. The Contractor shall warranty the complete system for a period of one (1) year from the date of Project acceptance and guarantee against all defects in material, equipment, and workmanship. The warranty shall include all parts, labor and shipment costs. Warranty period shall begin after installation, testing, and final acceptance. This is in addition to any other warranty provisions between Contractor and fluoridation system manufacturer.

1.04 SUBMITTALS

A. The following product data shall be submitted by the fluoride feed system manufacturer for review and approval by the engineer prior to the fabrication of the system:

B. Process and instrumentation diagram for system

C. Process and system sizing calculations specific to the required parameters per this specification

D. Scaled drawing of general arrangement and major system components

E. Material safety and data sheets (MSDS) for sodium fluoride

F. Major system component information and descriptive literature for the following:

1. Fluoride solution metering pump

2. Saturator and storage tanks

3. System controls and control panel including power and control wiring and logic diagrams, terminals, electrical components, and numbering

4. Miscellaneous instrumentation and accessories

G. Installation instructions

H. References for at least five identical units that have been installed and have been in operation for at least one year of continuous service.

1.05 OPERATION AND MAINTENANCE MANUALS

A. Detailed operation and maintenance (O&M) manual for the system shall be provided by the manufacturer. Refer to Section 01330 for the total number of copies of O&M manuals required.

1.06 OPERATING REQUIREMENTS

A. The fluoride system shall be designed to meet the following requirements

Item	Value
Design Water Treatment Capacity, gpm	3,080
Naturally Occurring F Residual, mg/L	0.48
Carbonate Hardness, mg/L	14.02
Total Hardness, grains per gallon	0.82
Target F Residual, mg/L	0.80
Target F Dosing Rate, mg/L	0.32
Sodium Fluoride Solution Strength, percent	4
Solution Feed Rate at Design Capacity and Target Dosing Rate, gph	3.13
Minimum Metering Pump Capacity at Maximum Frequency and Stroke Adjustment, gph	3.7
Maximum Metering Pump Capacity at Maximum Frequency and Stroke Adjustment, gph	5.0
Saturator Tank Sodium Fluoride Capacity, lbs	400
Minimum Saturator Tank Capacity, gallons	80
Minimum Solution Tank Capacity, gallons	80

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide saturator, saturated sodium fluoride solution storage tank, metering pump, water feed system, electrical control, and all other required appurtenances which are assembled in a completely self-contained, fluoride saturator and feed system package. The entire system shall be pre-assembled, piped, wired, factory tested and shipped as a single unit. Loose components shall not be acceptable.

2.02 SATURATOR AND SOLUTION STORAGE TANKS

A. The system shall have two tanks associated with the process (A saturator tank and a sodium fluoride solution storage tank).

1. Tanks shall be made from linear polyethylene with a wall thickness of ¼”. Tanks shall have visible calibration marks.

2. Tanks shall each have the capacity as specified herein.

3. Tanks shall be distributed by Ryan Herco Products, model P/N 7110.016 or approved equal.

4. Tanks shall have a hinged top distributed by Ryan Herco Products, model P/N 7122.016, or approved equal.

2.03 CHEMICAL METERING PUMP

A. The chemical metering pump shall be provided to deliver 4% sodium fluoride solution.

B. The chemical metering pump shall have a maximum capacity within the range as specified at maximum stroke and frequency. The chemical metering pump shall include an integral totalizer.

C. The chemical metering pump shall be a microprocessor-controlled, simplex, solenoid-driven reciprocating, and mechanically-actuated diaphragm type pump. All pumping functions shall be set by membrane-switch keypad and displayed on a legible, illuminated-LCD display. Keypad will allow for simple scrolling and display of programmed parameters. The housing shall be rated NEMA 4X.

D. The power supply shall be 120 VAC, 60 Hz, single phase. The microprocessor is to automatically compensate for supply voltage variations within 15% of the rated voltage such that the frequency of the pump remains constant.

E. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the solenoid if the primary diaphragm fails. The diaphragm shall be constructed of a steel core, vulcanized into nylon-reinforced EPDM, with PTFE faced fluid contact surface.

F. The pump shall utilize Opto-Drive® technology or approved equal whereby the time sequence of the dosing flow can be exactly matched to the requirements of the application.

G. The pump shall have Opto-Guard® technology, or approved equal, integrated into the drive to detect blocked metering points or broken metering lines, and to detect airlocks within the delivery unit.

H. The liquid end shall be constructed of PVDF with Teflon seals with a built-in coarse valve and needle valve for air bleed, manually adjusted for continuous degassing of process fluid and self-priming against pressure. The suction and discharge valves shall be of the double ball check design for discharge pressures greater than 100 psi.

I. Programming and Control:

1. Stroke length control shall have manual adjustment capability between 0% and 100% with a stroke adjustment knob on the pump face control; The LCD shall digitally display stroke length setting in 1% increments in the full range between 0% and 100%.

2. Programming shall allow pump to be calibrated so as to display pump output in gallons/hour. Calibration shall be maintained when stroke length is altered up to plus or minus 10% on the stroke length knob. If stroke length is altered by more than 10%, a yellow warning will light and a flashing message “calib” will appear.

3. Keypad shall allow for scrolling and shall display parameters such as stroke frequency, stroke length, stroke counter, pump output in gph, dosing quantity, mA current input being received by pump, and indication of external mode.

4. Stroke frequency control shall be manually adjusted by touch keypads, with the set stroke rate displayed on the LCD.

5. The pump shall accept an analog signal such that stroke frequency is proportional to 4-20mA. The pump shall allow the setting of a maximum stroke rate which corresponds to the maximum analog signal, with stroke rate proportional to signal strength below that rate. Analog to digital converters external to the pump shall not be allowed.

J. The pump shall be series DELTA with OptoDrive manufactured by ProMinent, equivalent by Pulsafeeder, or approved equal. The metering pump shall have ANSI/NSF-61 certification.

K. Accessories:

1. Back Pressure Valve – Back Pressure Valve shall be ½-inch socket ends and constructed of PVC body with PTFE diaphragm. Back pressure valve shall be field adjustable from 15 to 150 PSI. Initial factory setting shall be 50 PSI.

2. Control Cable – 15-Foot Control cable will be supplied.

3. Wall Mount Bracket shall be supplied.

2.04 SATURATOR WATER FEED SYSTEM AND APPURTENANCES

A. Available water supply for the saturator has a low hardness of the amount as specified herein; therefore, no additional water softening equipment is required. Water flow rate shall be as required by the equipment supplier, at 30 psig minimum available pressure. Contractor to provide an NSF 61 certified lead free bronze or brass, or stainless steel pressure reducing valve on the inlet water supply to regulate incoming pressure to the manufacturer's required pressure.

B. The water feed system shall include the following:

1. Clear filter housing

2. Water feed solenoid valve

3. Flow control needle valve

4. Backflow/Anti-siphon valve

5. Rotameter

6. All piping shall be SCH 80 PVC.

C. The sodium fluoride solution tank shall be equipped with an ultrasonic level switch for automatic control of the saturator operation. Ultrasonic level switch shall be Flowline Echopod DS 14-00, or equal.

2.05 SURFACE MOUNTED SOLUTION TANK MIXER

A. A general purpose mixer shall be installed in the solution tank as required. The mixer shall be NSF 61 certified for potable water use, or shall be coated with an NSF 61 approved coating on all surfaces exposed to the contents inside the solution tank.

B. The mixer operation shall be controlled by level switches in the solution tank and by an adjustable timer.

C. Surface mounted solution tank mixer shall meet the following terms:

1. Motor: 1/20 HP, 115V/60Hz/ 1 phase TEFC
2. Shaft: 316 stainless steel shaft
3. SS Impeller: 316 stainless steel fabricated to shaft

2.06 CALIBRATION COLUMN

A. A clear pvc calibration column shall be provided located between the saturator tank and the solution tank, with the bottom inlet of the calibration column plumbed to a bottom side outlet of the solution tank. A pvc isolation valve shall be provided on the piping between the solution tank outlet and the calibration column inlet. An additional outlet and pvc isolation valve shall be provided to allow the metering pump suction to draw fluid from the calibration column while the isolation valve between the solution tank outlet and the calibration column inlet is in either or closed or open state. Calibration column capacity shall be 250 mL.

2.07 ELECTRICAL CONTROL PANEL

A. The electrical control panel shall provide electrical control for the entire system including metering pump, saturator water feed control, level switches, and alarms.

B. The control panel enclosure shall be rated NEMA 4X. The panel shall be mounted on the system skid and factory pre-wired to system components.

C. The panel shall have the flowing components or functionality:

1. “Power On” green indicator light
2. “Hand-Off-Auto” switch for chemical metering pump
3. “Fluoride Pump On” green indicator light
4. “Containment Level Warning” red pilot indicator light
5. Timer control for the solution tank mixer
6. A high-level switch and alarm shall be provided for secondary containment to shut off the system in case of level detection.
7. Solution tank shall be provided with an ultrasonic level switch to turn the saturator operation on and off.

2.08 FIBERGLASS REINFORCED PLASTIC CONTAINMENT STRUCTURE

A. The entire system shall be housed in a single piece structure made of vinyl ester fiberglass reinforced plastic. No other material of construction is acceptable.

B. The structure shall also serve as a secondary containment unit.

C. Containment structure will have a high level switch to detect a breach event that is captured in the unit. The level switch will activate an alarm at the control panel.

D. Containment structure shall be anchored with 316SS anchor bolts.

PART 3 - EXECUTION

3.01 FACTORY ASSEMBLY AND TESTING

A. Each system shall be pre-assembled at the manufacturing location.

B. System(s) shall be tested at the location of assembly to assure they are in full operational and working order per the requirements of the specific design(s) for the project and this specification.

C. Factory testing shall include visual inspection of all equipment, complete assembly and functional testing of equipment including tank hydrotest, piping and instrumentation check, verification of control panel wiring and operation.

3.02 DELIVERY, INSTALLATION, AND STARTUP

A. System shall be packaged and shipped so as not to incur damage to any portion of the unit through handling and installation of the unit itself.

B. System shall be installed per the manufacturer's guidelines and recommendations.

C. A factory representative from manufacturer shall be present at the jobsite for initial system start-up and commissioning of equipment as specified. Factory representative will insure that system is properly installed, will start-up the system and train owner's personnel.

D. The system manufacturer representative shall be present at the jobsite for the following time period after the system is installed, travel time excluded:

1. Eight (8) hours for system startup, functional testing, and certification of proper installation.

2. Eight (8) hours for operator training for overall operation, maintenance and trouble-shooting for the system.

3. Provide one trip for 2 days for tasks 1 and 2 above.

3.03 SODIUM FLUORIDE

A. Initial 400-lb fill of sodium fluoride crystals shall be provided by the Contractor, upon Engineer review approval of submittal information containing the chemical supplier information and chemical data sheets for the sodium fluoride crystals provided.

3.04 IDENTIFICATION AND MARKING

A. The self-contained fluoride upflow saturator and feed system, along with applicable components shall be marked and identified for all health, flammability, and reactivity of hazardous materials as required by all applicable jurisdictional building codes, statutes, standards, regulations and laws.

END OF SECTION

SECTION 11301

VERTICAL TURBINE PUMPS – DEEP WELL

PART 1 - GENERAL

1.01 DESCRIPTION

A. Contractor shall furnish all materials, equipment, labor and incidentals necessary to furnish and place in operation vertical turbine pumps for deep well service, including all auxiliary equipment and accessories as shown on the Plans and as specified herein.

1.02 QUALITY ASSURANCE

A. All equipment furnished under this Section shall be a single manufacture who has been regularly engaged in the design and manufacture of the equipment, and demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein. The pump manufacturer shall have supplied complete units that have been in successful operation, at similar installations, for at least ten (10) years.

B. A single manufacturer shall be made responsible for furnishing the pumps and drives, and for coordination of design, assembly, testing, and installation of the pumps and suction barrels; however, the Contractor shall be responsible to the City for compliance with the requirements of these specifications.

C. Except as modified or supplemented herein, each vertical pump shall conform to the applicable requirements of ANSI/AWWA E101 and the Hydraulic Institute Standards. Specifically, each unit shall not develop at any frequency or in any plane, peak-to-peak vibration amplitudes in excess of Hydraulic Institute Standards.

D. Each complete pump shall be tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, which extends past the normal operating head range of the pump, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall be made in conformity with the requirements and recommendations of the Hydraulic Institute Standards.

E. Pump manufacturer shall perform a structural frequency analysis of the above ground structural components utilizing a FEA method to ensure that no structural frequencies occur within +/-20% of the operating speed range. When deemed necessary by the experience of the manufacturer, the below ground structural components shall also be included in the analysis. All pump assembly components including the motor shall be represented as solid elements, and if idealizations are used in place of solid elements, then a complete description of method for the idealization shall be included in the report.

F. The analysis shall also include all modes of interest and pictorially represent them in a fringe plot format. Modes of interest are defined as those structural frequencies that exist below 120% of the maximum operating speed. When significant modifications are required to lower the system's natural frequency, the pump

structure's stresses and deflections shall also be reviewed. Manufacturer shall provide documentation of the analysis ensuring that the specified requirements have been met. Test documentation shall be signed and stamped by the professionally licensed engineer who performed the analysis work.

G. Certified copies of a report covering each test shall be prepared by the pump manufacturer and delivered to the Engineer not less than 10 days prior to the shipment of the equipment from the factory. The report shall include data and test information as stipulated in the Hydraulic Institute Standards; copies of the testing log originals; and calculated field performance curves, based on shop tests, and corrected for headlosses in all portions of the pump column and for shaft bearing losses not included in the shop tests. The curves shall include pump total head, driver input and output horsepower, pump efficiency, and rpm, plotted against capacity. When the pump is not tested at the rated speed, performance charts shall include both the test and the calculated speed curves.

H. Shop tests shall demonstrate satisfactory performance at the minimum submergence conditions listed in the performance requirements. The Engineer may witness the certified factory tests. Notify the engineer a minimum of three weeks in advance of the scheduled tests. Upon receipt of the Engineer's favorable review, the pumps may be shipped to the job site.

1.03 SUBMITTALS

A. Prepare submittals in accordance with Section 01330. Complete assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted. The data and specifications for each pumping unit shall include, but shall not be limited to, the following.

1. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and the minimum submergence required at the rated flow conditions and the maximum and minimum flow conditions.

2. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

3. Submit complete dimensional drawings for all pump components. Coordinate equipment dimensions with the dimensional requirements as shown on the Drawings and as specified. Submit anchor bolts calculations meeting the requirements of Section 05501.

4. Electric motor data including: Name of manufacturer, type and model, rated size of motor (hp), temperature rating, full load rotative speed, efficiency at full load and rated pump condition, and full load current.

5. Complete electrical schematic diagram.

6. Manuals: Furnish five (5) complete copies of the manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and parts lists. Manuals shall provide all the information required to install,

operate and maintain the equipment in accordance with the standard provisions of all the manufacturer's warranty provisions.

7. Shop Test Data: Signed, dated and certified shop test data for each pump, submitted before shipment of equipment.

8. Coating materials, product data sheets on each type of paint and primer, and application instructions.

1.04 ENVIRONMENTAL CONDITIONS

A. The vertical pumps shall pump raw well water for potable use. The pumps shall operate singly and in groups and be suitable for long-term intermittent operation under constant speed drives as conditions require.

1.05 OPERATING REQUIREMENTS

A. The pumps shall be designed to meet the following conditions.

Item	Value
Number of pumps	1
Design flow capacity per pump, gpm	2,800
Design flow TDH at pump bowls, ft	170.7
Design flow minimum bowl efficiency, percent	82
Maximum flow capacity per pump, gpm	3,300
Maximum flow TDH at pump bowls, ft	140 +/- 20
Maximum flow minimum bowl efficiency, percent	82
Minimum flow capacity per pump, gpm	2,000
Minimum flow TDH at pump bowls, ft	200 +/- 20
Maximum shutoff head, ft	325
Maximum pump operating speed, rpm	1,770
Maximum motor operating speed, rpm	1,800
Motor size, hp	150
Nominal size of pump column, inches	12
Nominal size of pump discharge, inches	see Drawings
Minimum available submergence, ft.	80
Total column length (bottom of pump inlet to underside of pump discharge head)	220 +/- 5

B. The pump head as specified above is the sum of static lift and friction headloss in piping external to the pump. It does not include velocity head or hydraulic losses internal to the pump, including but not limited to, suction loss, column loss, discharge elbow loss, line shaft loss, and thrust bearing loss. The pump manufacturer shall calculate these losses and add them to the total head specified herein giving total dynamic head.

C. Pump shall have a continuously rising head/flow curve with no flat areas or reversals that will cause operating problems with varying static head conditions normal to well operations.

D. The performance of each pump shall be stable and free from damaging cavitation, vibration, and noise in the operating head range. Pump horsepower shall not exceed the motor rating at any point on the pump curve.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCT:

A. The pump shall be as manufactured by Floway, Flowserve, Peerless, Johnston (Sulzer), or approved equal, and modified as necessary to meet the requirements of this section. Pump manufacturer shall be ISO-9001 certified.

2.02 MATERIALS OF CONSTRUCTION

Pump Bowls	Cast Iron, ASTM A48, Class 30
Impellers	Bronze, ASTM B584, Alloy C90300
Bowl Wear Rings	Aluminum Bronze
Bowl Assembly and Top Line Shafts	Stainless Steel, Type 316
Bowl and Suction Bearings	Bronze, ASTM B505, product lubricated
Sand Collar	Bronze
Line Shafts	Stainless Steel, Type 416
Line Shaft Couplings	Stainless Steel, Type 316
Line Shaft Bearings – top 160’ of column length	Vesconite with bronze or ductile iron retainers
Line Shaft Bearings – below 160’ of column length	Neoprene or Styrene Butadene Rubber (SBR) with bronze or ductile iron retainers
Pump Column	ASTM A53, Grade B, Schedule 30 Steel Pipe with Threaded Couplings
Impeller Wear Rings	Aluminum Bronze, ASTM B505, Alloy 952/954, minimum 50 BHN difference between wear surfaces

2.03 EQUIPMENT FEATURES

A. Bowl Assembly

1. The impeller shaft shall be of stainless steel (not less than 12 percent chrome content) and shall be supported by bronze bearings located on both sides of each impeller.

2. The impellers shall be of the enclosed type and shall be of bronze, of heavy construction, accurately fitted, statically and dynamically balanced.

3. The impellers shall be adjustable by means of a shaft adjusting nut of the hollow shaft of the motor drive.

4. Bowls and impellers shall be equipped with wear rings designed to maintain pump efficiency. Wearing rings shall be securely locked in place so that they will not move or loosen during any condition of operation or handling, including reverse rotation of the pump.

5. Provide bell-mouth suction inlet with the outer diameter no larger than the largest outer diameter of any of the suction bowls.

B. Discharge Column Assembly

1. The total length of the discharge column shall be as specified.

2. Product lubricated column assembly in sections not over 20 feet in length. Top and bottom sections of column pipe shall not exceed 10 feet in length.

C. Sole Plate

1. Pump shall be provided with a sole plate to allow for level installation of the pump on the concrete mounting surface as shown on the Drawings.

2. Sole plate shall be factory primed, suitable for epoxy top coating by the Contractor in the field per Section 09900. The surface of the inner diameter of the hole for the pump discharge column does not need to be coated, but shall be protected from corrosion during transport.

3. Pump manufacturer shall furnish sole plate with an inner diameter which will allow the sole plate to clear the outer diameter of the well casing, and be field welded by the Contractor to the well casing as shown on the Drawings.

4. Sole plates shall be fabricated from minimum 1½-inch thick steel plate and shall be designed to support the weight of each pump and motor assembly with the pump column and discharge completely full of water, in addition to the pump thrust forces.

5. Each sole plate shall be drilled and tapped to accept studs for mounting and alignment of the pump discharge head base plate to the sole plate.

6. Sole plates shall be furnished by the pump manufacturer.

D. Discharge Head

1. The discharge head shall have an above floor base plate discharge and be constructed of cast iron or fabricated steel.

2. The discharge outlet shall terminate in a 150-pound flat face flange.

3. The pump shall have a minimum 1-inch thick discharge head base which shall transfer the weight of the pump, discharge elbow, motor and accessories to the sole plate.

4. Provide a full face neoprene gasket between the pump sole plate and the discharge head baseplate to provide a sanitary seal.

E. Shaft Seal

1. Provide mechanical seal, suitable for water flushing of the seal during pump operation, and pre-lubrication of column shaft bearings prior to pump start. Water flush and pre-lubrication shall be via a solenoid valve operated external potable water source prior to pump start and during pump operation as shown on the Drawings.

2. Mechanical seals shall be the cartridge type, requiring no field assembly, other than insertion into the pump.

3. Metal parts shall be Type 316 or 316L stainless steel.

4. Springs shall be Hastelloy C.

5. Rotary faces shall be tungsten carbide, carbon, or silicon carbide.

6. Stationary faces shall be ceramic, tungsten carbide, or silicon carbide.

F. Pump Construction

1. Shaft diameter shall be not less than the minimum permitted by AWWA E101 for the applicable driver nameplate horsepower rating.

2. Shafts shall have a first critical speed not less than 20 percent above maximum operating speed. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided.

3. Provide type 316 stainless steel bolts on entire pump unit.

G. Coatings

1. Provide fusion bonded, NSF-61 approved, epoxy coatings on pump bowl interior and exterior, column interior, below base plate exterior surfaces, and discharge head waterways.

2. Prime coat all other exposed metal surfaces above the base plate, including the base plate, in the shop prior to delivery to the site with a minimum 3 mils of polyamide, anticorrosive epoxy metal primer measured as a dry film thickness. Surface preparation and application shall be as recommended by coating material manufacturer.

3. Approved submittal data identifying the shop primer used shall be provided to the onsite finish coat applicator and to the Engineer before delivery of items to the job site.

4. Correct damage to the lining or coating to the satisfaction of the Engineer if in his opinion it is repairable. Return equipment which has damaged coating and/or damaged lining, beyond repair, to the manufacture for recoating.

5. The exterior surfaces of the pump column pipe shall remain bare and shall not receive any coating.

H. Accessories

1. Provide lifting lugs, coupling guards, and stainless steel identification name plate. Exposed moving parts shall be provided with OSHA approved guards. Guards shall be 14 gage expanded stainless steel designed for visual inspection of moving parts and ease of removal.

2. Provide Type 316 stainless steel anchor bolts sized by the manufacturer for securing suction can to concrete pad.

3. Provide seal leakage collector with a ½-inch tapped drain opening.

4. Provide all pump installations with pressure taps with pipe and gauge cocks on the discharge sides of the pump for field tests. Provide taps on the piping immediately downstream of the pump discharge head. Taps or tees in piping shall be 1-inch size with reduction to 1/2-inch at gauge connections.

5. Provide 1 inch pump barrel tap for air release valve.

6. One set of spare parts shall be furnished for each size pump as follows:

   a. 1 – Complete mechanical seal

   b. 1 – Full set of manufacturer's special tools which are necessary for the replacement of parts and the adjustment of the equipment.

I. Data Plates

1. Mount a data plate on each pump unit

2. Data plates shall contain the manufacture's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data. Attach a special data plate to the pump frame which contains identification of frame and bearing numbers.

2.04 DRIVE MOTORS

A. Motors shall be premium efficiency inverter duty built in accordance with NEMA MG 1, and to the requirements specified. Each pump shall be furnished with a vertical, heavy-duty, hollow shaft, squirrel-cage induction motor rated for 480 volts, 3-phase, 60 hz. Certified motor efficiency data shall be furnished to the pump supplier based on tests conducted on the motor.

B. The maximum permissible motor loading shall be 100 percent of the nameplate horsepower. Motor shall comply with noise criteria. Each pump unit shall not develop sound levels in excess of 75DBA within 25 feet at rated speed.

C. The motor top shaft shall be provided with a nonreversible ratchet device which prevents backspin of the pump.

D. The motor shall be equipped with a headshaft bushing at the lower end of the hollow shaft.

E. The motor must be equipped with a thrust bearing capable of supporting the maximum pump thrust, in addition to static and dynamic axial and radial loads.

F. Motors with frame sizes 182 and larger shall have cast iron frames and end shields. Motors shall be provided with condensation drain holes. Frame sizes 286 and larger shall have an automatic breather/drain device provided in the drain hole.

G. Motors shall have Class F insulation and be rated to operate at a maximum ambient temperature of 40°C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.42.

H. Motors shall have a removable eyebolt or have lifting lugs as an integral part of the frame.

I. Motors shall be designed for severe duty with TEFC motors and shall have:

1. Internal and external finish of rust resistant primer and two coats of epoxy paint

2. Corrosion-resistant plastic fans

3. Stainless steel hardware

J. Conduit Boxes

1. Conduit boxes shall be cast iron and shall be provided with threaded hubs. Motors shall be furnished with neoprene gaskets at the base of the conduit box and between the halves of the conduit box. Motors shall have UL listed clamp type grounding lug located within the box for the raceway ground connection. Separate gasketed conduit boxes shall be provided for devices. Conduit box finish shall match that of motor. Motor leads into the box shall have the same insulation class as the windings and shall have identification marks. Leads shall be sealed with a non-wicking, non-hydroscopic insulation. Solderless terminal connections shall be furnished on all leads. A grounding lug shall be provided in all motor conduit boxes. Motor conduit and conductor quantities and sizes are shown on the Plans. Motor conduit boxes shall be sufficiently sized to accommodate their termination.

K. Space Heaters

1. Motors shall be furnished with space heaters with wattage as required. The heater voltage and wattage shall be stamped or embossed on the motor nameplate. Space heaters shall be cartridge or flexible wrap-around type installed within motor enclosure adjacent to core iron. Leads shall be terminated in a separate conduit box.

L. Thermal Protection

1. Motors shall be provided with integral embedded winding temperature switches or other approved devices to protect the motor from overheating. Temperature switches or other devices shall be normally closed and rated 125 VAC, 1 amp. If remote conductivity relays are required, the motor vendor shall supply and coordinate their installation with the vendor of the motor starter and controls.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in strict conformance with manufacturer's installation instructions. Set impeller clearances, lubricate, and perform all adjustments and other tasks specified by the manufacturer. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings.

B. Connect discharge piping without imposing strain to pump flanges.

C. Anchor Bolts

1. Anchor bolts shall meet the requirements of Section 05501.

2. Accurately place using equipment templates.

D. Pump Sole Plate Installation

1. Install pump sole plates level in both directions, and as shown on the Drawings.

3.02 FIELD SERVICE

A. An authorized service representative of the Manufacturer shall be present at the site for a minimum of two (2) days to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation and to perform field adjustments to ensure that the equipment installation and operation comply with the specified requirements.

1. Installation of the equipment
2. Inspection, checking and adjusting the equipment
3. Startup and field testing for proper operation

3.03 FIELD PAINTING

A. Pumps, motors, and appurtenances shall receive a final color coat in the field in accordance with Section 09900.

3.04 TESTING

A. Performance Testing Grade

1. Pumps shall be tested per the latest edition of ANSI/HI 14.6, and to an acceptance grade of 1U for both factory and field tests.

B. Functional Tests

1. General

a. Conduct field performance tests to demonstrate that pump operation and controls meet the requirements specified in the above specifications.

2. Alignment

a. Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation. Monitor bearing areas on pump and motor for abnormally high temperatures.

3. Seal Water

a. Product lubricated bushings or seals with bypass flow for seal cooling and lubrication shall be tested for unobstructed free flow sufficient to provide required seal cooling during pump start and during normal operation.

C. Vibration Test

1. Conduct tests all with units installed, in normal operation, and discharging to the connected piping systems at rates between the high and low discharge head conditions specified.

2. In order to ensure that neither harmful nor damaging vibrations occur to the pump structure at any speed within the specified operating range, the pump manufacturer shall perform a structural frequency analysis of the above ground structural components utilizing a FEA method to ensure that no structural frequencies occur within +/-20 percent of the operating speed range. When deemed necessary by the experience of the manufacturer, the below ground structural components shall also be included in the analysis.

3. Manufacturer to provide documentation of the analysis ensuring that the specified requirements have been met, and that documentation should be signed and stamped by the professionally licensed engineer who performed the analysis work.

4. If pump units exhibit vibration in excess of the limits specified adjust or modify as necessary. Units which cannot be adjusted or modified to conform as specified shall be replaced.

D. Sound Test

1. Conduct tests all with units installed, in normal operation, and discharging to the connected piping systems at rates between the high discharge head conditions specified.

2. Each unit shall not develop sound levels in excess of 75DBA within 25 feet at rated speed.

3. If pump units exhibit noise in excess of the limits specified adjust or modify as necessary. Units which cannot be adjusted or modified to conform as specified shall be replaced.

3.05 INSTRUCTION OF CITY STAFF

A. An authorized training representative of the Manufacturer shall be present at the site for a minimum of one (1) day to instruct the City staff in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

B. The representative shall have at least two years' experience in training. Training shall be scheduled a minimum of three weeks in advance.

END OF SECTION

SECTION 11302

VERTICAL TURBINE PUMPS – RAW WATER

PART 1 - GENERAL

1.01 DESCRIPTION

A. Contractor shall furnish all materials, equipment, labor and incidentals necessary to furnish and place in operation vertical turbine raw water booster pumps, including all auxiliary equipment and accessories as shown on the Plans and as specified herein.

B. Wherein the terms “raw water booster pump”, “methane booster pump”, or “methane sump pump” are referred to within the Contract Documents, they are to be considered equal and are one in the same.

1.02 QUALITY ASSURANCE

A. All equipment furnished under this Section shall be a single manufacture who has been regularly engaged in the design and manufacture of the equipment, and demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein. The pump manufacturer shall have supplied complete units that have been in successful operation, at similar installations, for at least ten (10) years.

B. A single manufacturer shall be made responsible for furnishing the pumps, drives, sole plates, and for coordination of design, assembly, testing, and installation of the pumps; however, the Contractor shall be responsible to the City for compliance with the requirements of these specifications.

C. Except as modified or supplemented herein, each vertical pump shall conform to the applicable requirements of ANSI/AWWA E101 and the Hydraulic Institute Standards. Specifically, each unit shall not develop at any frequency or in any plane, peak-to-peak vibration amplitudes in excess of Hydraulic Institute Standards.

D. Each complete pump shall be tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, which extends past the normal operating head range of the pump, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall be made in conformity with the requirements and recommendations of the Hydraulic Institute Standards.

E. Pump manufacturer shall perform a structural frequency analysis of the above ground structural components utilizing a FEA method to ensure that no structural frequencies occur within +/-20% of the operating speed range. When deemed necessary by the experience of the manufacturer, the below ground structural components shall also be included in the analysis. All pump assembly components including the motor shall be represented as solid elements, and if idealizations are used in place of solid elements, then a complete description of method for the idealization shall be included in the report.

F. The analysis shall also include all modes of interest and pictorially represent them in a fringe plot format. Modes of interest are defined as those structural frequencies that exist below 120% of the maximum operating speed. When significant modifications are required to lower the system's natural frequency, the pump structure's stresses and deflections shall also be reviewed. Manufacturer shall provide documentation of the analysis ensuring that the specified requirements have been met. Test documentation shall be signed and stamped by the professionally licensed engineer who performed the analysis work.

G. Certified copies of a report covering each test shall be prepared by the pump manufacturer and delivered to the Engineer not less than 10 days prior to the shipment of the equipment from the factory. The report shall include data and test information as stipulated in the Hydraulic Institute Standards; copies of the testing log originals; and calculated field performance curves, based on shop tests, and corrected for headlosses in all portions of the pump column and for shaft bearing losses not included in the shop tests. The curves shall include pump total head, driver input and output horsepower, pump efficiency, and rpm, plotted against capacity. When the pump is not tested at the rated speed, performance charts shall include both the test and the calculated speed curves.

H. Shop tests shall demonstrate satisfactory performance at the minimum submergence conditions listed in the performance requirements. The Engineer may witness the certified factory tests. Notify the engineer a minimum of three weeks in advance of the scheduled tests. Upon receipt of the Engineer's favorable review, the pumps may be shipped to the job site.

1.03 SUBMITTALS

A. Prepare submittals in accordance with Section 01330. Complete assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted. The data and specifications for each pumping unit shall include, but shall not be limited to, the following.

1. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and the minimum submergence required at the rated flow conditions and the maximum and minimum flow conditions.

2. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

3. Submit complete dimensional drawings for all pump components. Coordinate equipment dimensions with the dimensional requirements as shown on the Drawings and as specified. Submit anchor bolts calculations meeting the requirements of Section 05501.

4. Electric motor data including: Name of manufacturer, type and model, rated size of motor (hp), temperature rating, full load rotative speed, efficiency at full load and rated pump condition, and full load current.

5. Complete electrical schematic diagram.

6. Manuals: Furnish five (5) complete copies of the manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and parts lists. Manuals shall provide all the information required to install, operate and maintain the equipment in accordance with the standard provisions of all the manufacturer's warranty provisions.

7. Shop Test Data: Signed, dated and certified shop test data for each pump, submitted before shipment of equipment.

8. Coating materials, product data sheets on each type of paint and primer, and application instructions.

1.04 ENVIRONMENTAL CONDITIONS

A. The vertical pumps shall pump chlorinated raw well water for potable use. The pumps shall operate singly and in groups and be suitable for long-term intermittent operation under variable speed drives as conditions require.

1.05 OPERATING REQUIREMENTS

A. The pumps shall be designed to meet the following conditions.

Item	Value
Number of pumps	2
Design flow capacity per pump, gpm	1,650
Design flow TDH at pump bowls, ft	47
Design flow minimum bowl efficiency, percent	79
Maximum flow capacity per pump, gpm	2,000
Maximum flow TDH at pump bowls, ft	35 +/- 5
Maximum flow minimum bowl efficiency, percent	66
Minimum flow capacity per pump, gpm	1,200
Minimum flow TDH at pump bowls, ft	56 +/- 5
Minimum flow minimum bowl efficiency, percent	74
Minimum flow at reduced speed, gpm	800
Minimum flow TDH at reduced speed, ft	30
Maximum shutoff head, ft	90
Maximum pump operating speed, rpm	1,770
Maximum motor operating speed, rpm	1,800
Motor size, hp	30
Nominal size of pump column, inches	10
Nominal size of pump discharge, inches	12
Minimum available submergence, ft.	2.75

B. The pump head as specified above is the sum of static lift and friction headloss in piping external to the pump. It does not include velocity head or hydraulic losses internal to the pump, including but not limited to, suction loss, column loss, discharge elbow loss, line shaft loss, and thrust bearing loss. The pump

manufacturer shall calculate these losses and add them to the total head specified herein giving total dynamic head.

C. Pump shall have a continuously rising head/flow curve with no flat areas or reversals that will cause operating problems with variable frequency drive applications.

D. The performance of each pump shall be stable and free from damaging cavitation, vibration, and noise in the operating head range. Pump horsepower shall not exceed the motor rating at any point on the pump curve.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCTS:

A. The pumps shall be as manufactured by Floway, Flowserve, Peerless, Johnston (Sulzer), or approved equal, and modified as necessary to meet the requirements of this section. Pump manufacturer shall be ISO-9001 certified.

2.02 MATERIALS OF CONSTRUCTION:

Pump Bowls	Cast Iron, ASTM A48, Class 30
Impellers	Bronze, ASTM B584, Alloy C90300
Bowl Wear Rings	Aluminum Bronze
Bowl Assembly and Top Line Shaft	Stainless Steel, Type 316
Bowl and Suction Bearings	Bronze, ASTM B505, product lubricated
Sand Collar	Bronze
Line Shafts	Stainless Steel, Type 416
Line Shaft Couplings	Stainless Steel, Type 316
Line Shaft Bearings	Neoprene or Styrene Butadene Rubber (SBR) with bronze or ductile iron retainers
Pump Column	ASTM A53, Grade B, Schedule 30 Steel Pipe with Flanged Couplings.
Impeller Wear Rings	Aluminum Bronze, ASTM B505, Alloy 952/954, minimum 50 BHN difference between wear surfaces

2.03 EQUIPMENT FEATURES

A. Bowl Assembly

1. The impeller shaft shall be of stainless steel (not less than 12 percent chrome content) and shall be supported by bronze bearings located on both sides of each impeller.

2. The impellers shall be of the enclosed type and shall be of bronze, of heavy construction, accurately fitted, statically and dynamically balanced.

3. The impellers shall be adjustable by means of a solid adjustable spacer coupling.

4. Bowls and impellers shall be equipped with wear rings designed to maintain pump efficiency. Wearing rings shall be securely locked in place so that

they will not move or loosen during any condition of operation or handling, including reverse rotation of the pump.

5. Provide bell-mouth suction inlet with a Type 316 Stainless Steel suction strainer with anti-vortex baffles.

B. Discharge Column Assembly

1. The total length of the discharge column shall be as shown on the Plans.

2. Product lubricated column assembly in sections not over 10 feet in length. Top and bottom sections of column pipe shall not exceed 5 feet in length. The length of the pump column shall be sufficient to locate the suction inlet above the wetwell floor a distance of not less than 1/3 times the bell diameter nor more than 3/4 times the bell diameter.

C. Sole Plate

1. Each pump shall be provided with a sole plate to allow for level installation of the pump on the concrete mounting surface as shown on the Drawings.

2. Sole plates shall be factory primed, suitable for epoxy top coating by the Contractor in the field per Section 09900.

3. Pump manufacturer shall furnish sole plates with inner diameters compatible with largest outer diameter of any part of the pump below the discharge head to allow for installation and removal of the pumps.

4. Sole plates shall be fabricated from minimum 1-inch thick steel plate and shall be designed to support the weight of each pump and motor assembly with the pump column and discharge completely full of water, in addition to the pump thrust forces.

5. Each sole plate shall be drilled and tapped to accept studs for mounting and alignment of the pump discharge head base plate to the sole plate.

6. Sole plates shall be furnished by the pump manufacturer.

D. Discharge Head

1. The discharge head shall have an above floor base plate discharge and be constructed of cast iron or fabricated steel.

2. The discharge outlet shall terminate in a 150-pound flat face flange.

3. Each pump shall have a minimum 1-inch thick discharge head base which shall transfer the weight of the pump, discharge elbow, motor and accessories to the sole plate.

4. Provide a full face neoprene gasket between the pump sole plate and the discharge head baseplate to provide a sanitary seal.

E. Shaft Seal

1. Provide with stuffing box, gland, and gland nut suitable for packing and lantern rings for each pump. Provide shaft with hard chrome journal at stuffing box location.

F. Pump Construction

1. Shaft diameter shall be not less than the minimum permitted by AWWA E101 for the applicable driver nameplate horsepower rating.

2. Shafts shall have a first critical speed not less than 20 percent above maximum operating speed. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided.

3. Motor shaft coupling: 3-piece, heavy-duty adjustable spacer coupling, to allow for raising or lowering the shafting to properly center the impellers in the bowls, and to allow for seal packing to be removed and replaced without removal of the motor.

4. Provide type 316 stainless steel bolts on entire pump unit.

G. Coatings

1. Provide fusion bonded, NSF-61 approved, epoxy coatings on pump bowl and column interior and exterior, below base plate exterior surfaces, and discharge head waterways.

2. Prime coat all other exposed metal surfaces above the base plate, including the base plate, in the shop prior to delivery to the site with a minimum 3 mils of polyamide, anticorrosive epoxy metal primer measured as a dry film thickness. Surface preparation and application shall be as recommended by coating material manufacturer.

3. Approved submittal data identifying the shop primer used shall be provided to the onsite finish coat applicator and to the Engineer before delivery of items to the job site.

4. Correct damage to the lining or coating to the satisfaction of the Engineer if in his opinion it is repairable. Return equipment which has damaged coating and/or damaged lining, beyond repair, to the manufacture for recoating.

H. Accessories

1. Provide lifting lugs, coupling guards, and stainless steel identification name plate. Exposed moving parts shall be provided with OSHA approved guards. Guards shall be 14 gage expanded stainless steel designed for visual inspection of moving parts and ease of removal.

2. Provide seal leakage collector with a ½-inch tapped drain opening.

3. Provide all pump installations with pressure taps with pipe and gauge cocks on the discharge sides of the pump for field tests. Provide taps on the piping immediately downstream of the pump discharge head. Taps or tees in piping shall be 1-inch size with reduction to 1/2-inch at gauge connections.

4. One set of spare parts shall be furnished for each size pump as follows:

   a. 1 – Complete set of packing for stuffing box

   b. 1 – Full set of manufacturer's special tools which are necessary for the replacement of parts and the adjustment of the equipment.

I. Data Plates

1. Mount a data plate on each pump unit

2. Data plates shall contain the manufacture's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data. Attach a special data plate to the pump frame which contains identification of frame and bearing numbers.

2.04 DRIVE MOTORS

A. Motors shall be premium efficiency inverter duty built in accordance with NEMA MG 1, and to the requirements specified. Each pump shall be furnished with a vertical, heavy-duty, solid shaft, squirrel-cage induction motor rated for 480 volts, 3-phase, 60 hz. Certified motor efficiency data shall be furnished to the pump supplier based on tests conducted on the motor.

B. The maximum permissible motor loading shall be 100 percent of the nameplate horsepower. Motor shall comply with noise criteria. Each pump unit shall not develop sound levels in excess of 75DBA within 25 feet at rated speed.

C. The motor top shaft shall be provided with a nonreversible ratchet device which prevents backspin of the pump only for pumps with shafting assembled with threaded connections.

D. Motors with frame sizes 182 and larger shall have cast iron frames and end shields. Motors shall be provided with condensation drain holes. Frame sizes 286 and larger shall have an automatic breather/drain device provided in the drain hole.

E. Motors shall have Class F insulation and be rated to operate at a maximum ambient temperature of 40°C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.42.

F. Motors shall have a removable eyebolt or have lifting lugs as an integral part of the frame.

G. Motors shall be designed for severe duty with TEFC motors and shall have:

1. Internal and external finish of rust resistant primer and two coats of epoxy paint

2. Corrosion-resistant plastic fans

3. Stainless steel hardware

H. Conduit Boxes

1. Conduit boxes shall be cast iron and shall be provided with threaded hubs. Motors shall be furnished with neoprene gaskets at the base of the conduit box and between the halves of the conduit box. Motors shall have UL listed clamp type grounding lug located within the box for the raceway ground connection. Separate gasketed conduit boxes shall be provided for devices. Conduit box finish shall match that of motor. Motor leads into the box shall have the same insulation class as the windings and shall have identification marks. Leads shall be sealed with a non-wicking, non-hydroscopic insulation. Solderless terminal connections shall be furnished on all leads. A grounding lug shall be provided in all motor conduit boxes. Motor conduit and conductor quantities and sizes are shown on the Plans. Motor conduit boxes shall be sufficiently sized to accommodate their termination.

I. Space Heaters

1. Motors shall be furnished with space heaters with wattage as required. The heater voltage and wattage shall be stamped or embossed on the motor nameplate. Space heaters shall be cartridge or flexible wrap-around type installed within motor enclosure adjacent to core iron. Leads shall be terminated in a separate conduit box.

J. Thermal Protection

1. Motors shall be provided with integral embedded winding temperature switches or other approved devices to protect the motor from overheating. Temperature switches or other devices shall be normally closed and rated 125 VAC, 1 amp. If remote conductivity relays are required, the motor vendor shall supply and coordinate their installation with the vendor of the motor starter and controls.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in strict conformance with manufacturer's installation instructions. Set impeller clearances, lubricate, and perform all adjustments and other tasks specified by the manufacturer. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings.

B. Connect discharge piping without imposing strain to pump flanges.

C. Anchor Bolts

1. Anchor bolts shall meet the requirements of Section 05501.

2. Accurately place using equipment templates.

D. Pump Sole Plate Installation

1. Install pump sole plates level in both directions, and as shown on the Drawings.

3.02 FIELD SERVICE

A. An authorized service representative of the Manufacturer shall be present at the site for a minimum of two (2) days to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation and to perform field adjustments to ensure that the equipment installation and operation comply with the specified requirements.

1. Installation of the equipment

2. Inspection, checking and adjusting the equipment

3. Startup and field testing for proper operation

3.03 FIELD PAINTING

A. Pumps, motors, and appurtenances shall receive a final color coat in the field in accordance with Section 09900.

3.04 TESTING

A. Performance Testing Grade

1. Pumps shall be tested per the latest edition of ANSI/HI 14.6, and to an acceptance grade of 1U for both factory and field tests.

B. Functional Tests

1. General

   a. Conduct field performance tests to demonstrate that pump operation and controls meet the requirements specified in the above specifications.

2. Alignment

   a. Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation. Monitor bearing areas on pump and motor for abnormally high temperatures.

3. Packing Gland

   a. Packing gland shall be adjusted and tested to provide required cooling of the packing during pump start and during normal operation. Initial adjustment shall be loose, followed by adjustment to a final setting to ensure initial pump testing does not begin on an overtightened packing adjustment.

C. Vibration Test

1. Conduct tests all with units installed, in normal operation, and discharging to the connected piping systems at rates between the high and low discharge head conditions specified.

2. In order to ensure that neither harmful nor damaging vibrations occur to the pump structure at any speed within the specified operating range, the pump manufacturer shall perform a structural frequency analysis of the above ground structural components utilizing a FEA method to ensure that no structural frequencies occur within +/-20 percent of the operating speed range. When deemed necessary by the experience of the manufacturer, the below ground structural components shall also be included in the analysis.

3. Manufacturer to provide documentation of the analysis ensuring that the specified requirements have been met, and that documentation should be signed and stamped by the professionally licensed engineer who performed the analysis work.

4. If pump units exhibit vibration in excess of the limits specified adjust or modify as necessary. Units which cannot be adjusted or modified to conform as specified shall be replaced.

D. Sound Test

1. Conduct tests all with units installed, in normal operation, and discharging to the connected piping systems at rates between the high discharge head conditions specified.

2. Each unit shall not develop sound levels in excess of 75DBA within 25 feet at rated speed.

3. If pump units exhibit noise in excess of the limits specified adjust or modify as necessary. Units which cannot be adjusted or modified to conform as specified shall be replaced.

3.05 INSTRUCTION OF CITY STAFF

A. An authorized training representative of the Manufacturer shall be present at the site for a minimum of one (1) day to instruct the City staff in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

B. The representative shall have at least two years' experience in training. Training shall be scheduled a minimum of three weeks in advance.

END OF SECTION

SECTION 11303

VERTICAL TURBINE PUMPS – BOOSTER PUMP STATION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor furnished materials, equipment, labor and incidentals necessary to furnish and place in operation vertical turbine pumps, including all auxiliary equipment and accessories as shown on the Plans and as specified herein.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals
2. Section 05501 – Anchor Bolts
3. Section 09900 – Coating System
4. Section 15100 – Valves and Appurtenances

1.03 QUALITY ASSURANCE

A. All equipment furnished under this Section shall be a single manufacture who has been regularly engaged in the design and manufacture of the equipment, and demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein. The pump manufacturer shall have supplied complete units that have been in successful operation, at similar installations, for at least ten (10) years.

B. A single manufacturer shall be made responsible for furnishing the pumps, drives, suction barrels and for coordination of design, assembly, testing, and installation of the pumps and suction barrels; however, the Contractor shall be responsible to the City for compliance with the requirements of these specifications.

C. Except as modified or supplemented herein, each vertical pump shall conform to the applicable requirements of ANSI/AWWA E-103 and the Hydraulic Institute Standards. Specifically, each unit shall not develop at any frequency or in any plane, peak-to-peak vibration amplitudes in excess of Hydraulic Institute Standards.

D. Each complete pump shall be tested at the factory for capacity, power requirement, and efficiency at minimum head, rated head, which extends past the normal operating head range of the pump, and at as many other points as necessary for accurate performance curve plotting. All tests and test reports shall be made in conformity with the requirements and recommendations of the Hydraulic Institute Standards.

E. Pump manufacturer shall perform a structural frequency analysis of the above ground structural components utilizing a FEA method to ensure that no structural frequencies occur within +/-20% of the operating speed range. When deemed necessary by the experience of the manufacturer, the below ground structural

components shall also be included in the analysis. All pump assembly components including the motor shall be represented as solid elements, and if idealizations are used in place of solid elements, then a complete description of method for the idealization shall be included in the report.

F. The analysis shall also include all modes of interest and pictorially represent them in a fringe plot format. Modes of interest are defined as those structural frequencies that exist below 120% of the maximum operating speed. When significant modifications are required to lower the system's natural frequency, the pump structure's stresses and deflections shall also be reviewed. Manufacturer shall provide documentation of the analysis ensuring that the specified requirements have been met. Test documentation shall be signed and stamped by the professionally licensed engineer who performed the analysis work.

G. Certified copies of a report covering each test shall be prepared by the pump manufacturer and delivered to the Engineer not less than 10 days prior to the shipment of the equipment from the factory. The report shall include data and test information as stipulated in the Hydraulic Institute Standards; copies of the testing log originals; and calculated field performance curves, based on shop tests, and corrected for headlosses in all portions of the pump column and for shaft bearing losses not included in the shop tests. The curves shall include pump total head, driver input and output horsepower, pump efficiency, and rpm, plotted against capacity. When the pump is not tested at the rated speed, performance charts shall include both the test and the calculated speed curves.

H. Shop tests shall demonstrate satisfactory performance at the minimum submergence conditions listed in the performance requirements. The Engineer may witness the certified factory tests. Notify the engineer a minimum of three weeks in advance of the scheduled tests. Upon receipt of the Engineer's favorable review, the pumps may be shipped to the job site.

1.04 SUBMITTALS

A. Prepare submittals in accordance with Section 01330. Complete assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted. The data and specifications for each pumping unit shall include, but shall not be limited to, the following.

B. Performance data curves showing head, capacity, horsepower demand, NPSH required, and pump efficiency over the entire operating range of the pump. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and the minimum submergence required at the rated flow conditions and the maximum and minimum flow conditions.

C. Assembly and installation drawings including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.

D. Submit complete dimensional drawings for all pump and barrel components. Coordinate equipment dimensions with the structural pump encasement requirements. Submit anchor bolts calculations meeting the requirements of Section 05501.

E. Electric motor data including: Name of manufacturer, type and model, rated size of motor (hp), temperature rating, full load rotative speed, efficiency at full load and rated pump condition, and full load current.

F. Complete electrical schematic diagram.

G. Manuals: Furnish five (5) complete copies of the manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and parts lists. Manuals shall provide all the information required to install, operate and maintain the equipment in accordance with the standard provisions of all the manufacturer's warranty provisions.

H. Shop Test Data: Signed, dated and certified shop test data for each pump, submitted before shipment of equipment.

I. Contractor's vertical turbine pump suction barrel submittal shall be completed and submitted to the Engineer within 30 working days from Notice to Proceed. Suction barrel shall be fabricated and shipped prior to pump delivery as required to facilitate construction of pump station foundation.

J. Coating materials, product data sheets on each type of paint and primer, and application instructions.

1.05 ENVIRONMENTAL CONDITIONS

A. The vertical pumps shall pump treated drinking water. The pumps shall operate singly and in groups and be suitable for long-term intermittent operation under constant or variable speed drives as conditions require. Available suction bowl submergence is 5 feet minimum.

1.06 OPERATING REQUIREMENTS

A. The pumps shall be designed to meet the following conditions.

Item	Value
Number of pumps	4
Number of suction barrels	4
Rated head, ft.	110
Capacity at rated head, gpm each pump	2,800
Maximum pump operating speed, rpm	1,750
Minimum bowl efficiency at rated head, percent	82
Minimum nominal size of pump column, inches	10
Minimum nominal size of pump discharge, inches	10
Motor size, hp	150
Minimum suction barrel diameter, inches	24
Suction barrel inlet diameter, inches	16

B. The pump head as specified above is the sum of static lift and friction headloss in piping external to the pump. It does not include velocity head or hydraulic losses internal to the pump, including but not limited to, suction loss, column loss, discharge elbow loss, line shaft loss, and thrust bearing loss. The pump

manufacturer shall calculate these losses and add them to the total head specified herein giving total dynamic head.

C. Pump shall have a continuously rising head/flow curve with no flat areas or reversals that will cause operating problems with variable frequency drive applications.

D. The performance of each pump shall be stable and free from damaging cavitation, vibration, and noise in the operating head range. Pump horsepower shall not exceed the motor rating at any point on the pump curve.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCTS:

A. The pumps shall be as manufactured by Flowserve, Floway, or Peerless, and modified as necessary to meet the requirements of this section. Pump manufacturer shall be ISO-9001 certified.

2.02 MATERIALS OF CONSTRUCTION:

Pump Bowls	Cast Iron, ASTM A48, Class 30
Impellers	952 Bronze, ASTM B584-90b Alloy 952
Bowl Wear Rings	Bronze
Bowl Assembly and Top Line Shaft	Stainless Steel, Type 316
Bowl and Suction Bearings	Bronze, ASTM B505, product lubricated
Sand Collar	Bronze
Line Shafts	Stainless Steel, Type 416
Line Shaft Couplings	Stainless Steel, Type 316
Line Shaft Bearings	Neoprene with bronze retainers
Pump Column	ASTM A53, Grade B, Schedule 30 Steel Pipe with Flanged Couplings.
Impeller Wear Ring	Bronze, ASTM B505, Alloy 952

2.03 EQUIPMENT FEATURES

A. Bowl Assembly

1. The impeller shaft shall be of stainless steel (not less than 12 percent chrome content) and shall be supported by bronze bearings located on both sides of each impeller.

2. The impellers shall be of the enclosed type and shall be of bronze, of heavy construction, accurately fitted, statically and dynamically balanced.

3. The impellers shall be adjustable by means of a solid adjustable spacer coupling.

4. Bowls and impellers shall be equipped with wear rings designed to maintain pump efficiency. Wearing rings shall be securely locked in place so that they will not move or loosen during any condition of operation or handling, including reverse rotation of the pump.

5. Provide bell-mouth suction inlet with a Type 316 Stainless Steel suction strainer with anti-vortex baffels.

B. Discharge Column Assembly

1. The total length of the discharge column shall be as shown on the Plans. The column pipe shall be schedule 30 steel.

2. Product lubricated flanged column assembly in sections not over 10 feet in length. Top and bottom sections of column pipe shall not exceed 5 feet in length. The length of the pump column shall be sufficient to locate the suction inlet above the barrel floors a distance of not less than 1/3 times the bell diameter nor more than 3/4 times the bell diameter.

C. Suction Barrels

1. Fabricated steel pipe and pipe specials in accordance with Section 15100 and epoxy lined and coated per Section 09900. Barrel flanges to mate with discharge head base flange with O-ring groove for proper sealing. Suction barrels shall be tested and free of leaks at a pressure of 75 psi.

2. Pump suction barrels shall be 3/8-inch thick steel minimum, dimensions and configuration as shown on the drawings and specified herein, with 2-inch anti-vortex sidewall vanes and 2-inch anti-vortex cross installed on inside bottom of vessel.

3. Prior to coating, fully weld anti-vortex vanes to suction barrel along complete length of each vane. Also fully weld bottom cross vane to bottom plate of suction barrel.

4. Pump manufacturer shall furnish a suction barrel with a diameter compatible with pump bowls and shall not be smaller than size listed on Drawings.

5. Furnish suction barrel with flange to match discharge head flange.

6. Flange shall be 1-inch minimum thickness welded inside and outside at top of can.

7. The pumps and suction barrels shall be furnished by the same manufacturer. Pump supplier shall coordinate pump/can connection details.

8. Barrel requiring touch-up or coating repair shall be repaired using materials from same manufacturer as the fusion-bonded epoxy using a liquid epoxy patching compound; coating repair per Section 3.4 of AWWA C213. Field coating repair shall use ScotchKote 312 or equal.

9. Interior and exterior of pump suction barrels shall be coated per AWWA C213 - Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines. The coating thickness shall be a minimum of 12 mils. Coating shall be Scotchkote 206N or equal, NSF approved for potable water service.

10. Provide each barrel with ANSI B 16.5 150 LB inlet flange.

D. Discharge Head

1. The discharge head shall have an above floor base plate discharge and be constructed of fabricated steel.

2. The discharge outlet shall terminate in a 150-pound flat face flange.

3. Each pump shall have a minimum 1.5-inch thick base discharge head which shall transfer the weight of the pump, discharge elbow, motor and accessories to the suction can flange.

E. Mechanical Seals

1. Mechanical seals shall be the cartridge type, requiring no field assembly, other than insertion into the pump.

2. Metal parts shall be Type 316 or 316L stainless steel.

3. Springs shall be Hastelloy C.

4. Rotary faces shall be tungsten carbide, carbon, or silicon carbide.

5. Stationary faces shall be ceramic, tungsten carbide, or silicon carbide.

6. Furnish Plan 13 Seal Flush piping.

F. Pump Construction

1. Shaft diameter shall be not less than the minimum permitted by AWWA E101 for the applicable driver nameplate horsepower rating.

2. Shafts shall have a first critical speed not less than 20 percent above maximum operating speed. Excessive vibration shall be sufficient cause for rejection of the equipment. The mass of the unit and its distribution shall be such that resonance at normal operating speeds is avoided.

3. Motor shaft coupling: 4-piece, heavy-duty adjustable coupling, to allow for raising or lowering the shafting to properly center the impellers in the bowls.

4. Provide type 316 stainless steel bolts on entire pump unit.

G. Coatings

1. Provide fusion bonded, NSF-61 approved, epoxy coatings on pump bowl and column interior and exterior, below base plate exterior surfaces, and discharge head waterways.

2. Prime coat all other exposed metal surfaces above the base plate, including the base plate, in the shop prior to delivery to the site with a minimum 3 mils of polyamide, anticorrosive epoxy metal primer measured as a dry film thickness. Surface preparation and application shall be as recommended by coating material manufacturer.

3. Approved submittal data identifying the shop primer used shall be provided to the onsite finish coat applicator and to the Engineer before delivery of items to the job site.

4. Correct damage to the lining or coating to the satisfaction of the Engineer if in his opinion it is repairable. Return equipment which has damaged coating and/or damaged lining, beyond repair, to the manufacture for recoating.

H. Accessories

1. Provide lifting lugs, coupling guards, and stainless steel identification name plate. Exposed moving parts shall be provided with OSHA

approved guards. Guards shall be 14 gage expanded stainless steel designed for visual inspection of moving parts and ease of removal.

2. Provide Type 316 stainless steel anchor bolts sized by the manufacturer for securing suction can to concrete pad.

3. Provide seal leakage collector with a ½-inch tapped drain opening.

4. Provide all pump installations with pressure taps with pipe and gauge cocks on the discharge sides of the pump for field tests. Provide taps on the piping immediately downstream of the pump discharge head. Taps or tees in piping shall be 1-inch size with reduction to 1/2-inch at gauge connections.

5. Provide 1 inch pump barrel tap for air release valve.

6. Spare Parts

7. One set of spare parts shall be furnished for each size pump as follows:

   a. 1 – Complete mechanical seals

   b. 1 – Full set of manufacturer's special tools which are necessary for the replacement of parts and the adjustment of the equipment.

I. Data Plates

1. Mount a data plate on each pump unit

2. Data plates shall contain the manufacture's name, pump size and type, serial number, speed, impeller diameter, capacity and head rating, and other pertinent data. Attach a special data plate to the pump frame which contains identification of frame and bearing numbers.

2.04 DRIVE MOTORS

A. Motors shall be premium efficiency inverter duty built in accordance with NEMA MG 1, and to the requirements specified. Each pump shall be furnished with a vertical, heavy-duty, solid shaft, squirrel-cage induction motor rated 480 volts, 3-phase, 60 hz. Certified motor efficiency data shall be furnished to the pump supplier based on tests conducted on the motor.

B. The maximum permissible motor loading shall be 100 percent of the nameplate horsepower. Motor shall comply with noise criteria. Each pump unit shall not develop sound levels in excess of 75DBA within 25 feet at rated speed.

C. The motor top shaft shall be provided with a nonreversible ratchet device which prevents backspin of the pump.

D. Motors with frame sizes 182 and larger shall have cast iron frames and end shields. Motors shall be provided with condensation drain holes. Frame sizes 286 and larger shall have an automatic breather/drain device provided in the drain hole.

E. Motors shall have Class F insulation and be rated to operate at a maximum ambient temperature of 40°C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in ANSI/NEMA MG 1-12.42.

F. Motors shall have a removable eyebolt or have lifting lugs as an integral part of the frame.

G. Motors shall be designed for severe duty with TEFC motors and shall have:

1. Internal and external finish of rust resistant primer and two coats of epoxy paint
2. Corrosion-resistant plastic fans
3. Stainless steel hardware

H. Conduit Boxes

1. Conduit boxes shall be cast iron and shall be provided with threaded hubs.
2. Motors shall be furnished with neoprene gaskets at the base of the conduit box and between the halves of the conduit box.
3. Motors shall have UL listed clamp type grounding lug located within the box for the raceway ground connection.
4. Separate gasketed conduit boxes shall be provided for devices. Conduit box finish shall match that of motor.
5. Motor leads into the box shall have the same insulation class as the windings and shall have identification marks.
6. Leads shall be sealed with a non-wicking, non-hydroscopic insulation.
7. Solderless terminal connections shall be furnished on all leads.
8. A grounding lug shall be provided in all motor conduit boxes.
9. Motor conduit and conductor quantities and sizes are shown on the Plans.
10. Motor conduit boxes shall be sufficiently sized to accommodate their termination.

I. Space Heaters

1. Motors shall be furnished with space heaters with wattage as required.
2. The heater voltage and wattage shall be stamped or embossed on the motor nameplate.
3. Space heaters shall be cartridge or flexible wrap-around type installed within motor enclosure adjacent to core iron.
4. Leads shall be terminated in a separate conduit box.

J. Thermal Protection

1. Motors shall be provided with integral embedded winding temperature switches or other approved devices to protect the motor from overheating.
2. Temperature switches or other devices shall be normally closed and rated 125 VAC, 1 amp.
3. If remote conductivity relays are required, the motor vendor shall supply and coordinate their installation with the vendor of the motor starter and controls.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. Install equipment in strict conformance with manufacturer's installation instructions.
2. Set impeller clearances, lubricate, and perform all adjustments and other tasks specified by the manufacturer.
3. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings.
4. Connect discharge piping without imposing strain to pump flanges.

B. Anchor Bolts

1. Anchor bolts shall meet the requirements of Section 05501.
2. Accurately place using equipment templates.

C. Pump Barrel Installation

1. Install pump barrels beneath the pump station floor as shown on the Drawings.
2. Set pump barrels plumb within a tolerance of ¼ -inch from top of barrel to bottom of barrel.
3. Install the pump barrel with the pump mounting flange horizontal. The pump barrel shall be installed so the pump mounting flange is level within 0.001 inch per foot when measured along any horizontal axis.
4. The Contractor shall provide on-site machining of the pump barrel flange if the installation is not as level as stated above at no additional cost to the City.
5. Contractor shall provide written acceptance from the pump manufacturer that the pump barrel flanges have been checked for alignment and are certified as being within the required manufacturer's tolerance and as stated herein, prior to mounting the discharge heads on the pump barrels.
6. After the pump and driver have been set in position, grout the space between the bottom of the barrel flange and the concrete foundation with a poured, non-shrink grout.

3.02 FIELD SERVICE

A. An authorized service representative of the Manufacturer shall be present at the site for a minimum of two (2) days to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation and to perform field adjustments to ensure that the equipment installation and operation comply with the specified requirements.

1. Installation of the equipment
2. Inspection, checking and adjusting the equipment

3. Startup and field testing for proper operation

3.03 FIELD PAINTING

A. Pumps, motors, and appurtenances shall receive a final color coat in the field in accordance with Section 09900.

3.04 TESTING

A. Functional tests

1. General

a. Conduct field performance tests to demonstrate that pump operation and controls meet the requirements specified in the above specifications.

2. Alignment

a. Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation. Monitor bearing areas on pump and motor for abnormally high temperatures.

3. Cooling Water

a. Product lubricated bushings or seals with bypass flow for cooling shall be tested for unobstructed free flow sufficient to provide required cooling during pump start and during normal operation.

B. Vibration Tests

1. Conduct tests all with units installed, in normal operation, and discharging to the connected piping systems at rates between the high and low discharge head conditions specified.

2. In order to ensure that neither harmful nor damaging vibrations occur to the pump structure at any speed within the specified operating range, the pump manufacturer shall perform a structural frequency analysis of the above ground structural components utilizing a FEA method to ensure that no structural frequencies occur within +/-20 percent of the operating speed range. When deemed necessary by the experience of the manufacturer, the below ground structural components shall also be included in the analysis.

3. Manufacturer to provide documentation of the analysis ensuring that the specified requirements have been met, and that documentation should be signed and stamped by the professionally licensed engineer who performed the analysis work.

4. If pump units exhibit vibration in excess of the limits specified adjust or modify as necessary. Units which cannot be adjusted or modified to conform as specified shall be replaced.

C. Sound Test

1. Conduct tests all with units installed, in normal operation, and discharging to the connected piping systems at rates between the high discharge head conditions specified.

2. Each unit shall not develop sound levels in excess of 75DBA within 25 feet at rated speed.

3. If pump units exhibit noise in excess of the limits specified adjust or modify as necessary. Units which cannot be adjusted or modified to conform as specified shall be replaced.

3.05 INSTRUCTION OF CITY STAFF

A. An authorized training representative of the Manufacturer shall be present at the site for a minimum of one (1) day to instruct the City staff in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. Instruction shall be specific to the models of equipment provided.

B. The representative shall have at least two years' experience in training. Training shall be scheduled a minimum of three weeks in advance.

END OF SECTION

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SECTION 11355

UNDERDRAIN PUMP

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor furnished materials, equipment, labor, and incidentals necessary to provide and place in operation submersible pumps, including all auxiliary equipment and accessories as shown on the Plans and specified below. This section specifies submersible pumps complete with motor, discharge elbow, guide bar brackets, access frames and covers and accessories.

B. Design for continuous operation under submerged or partially submerged condition without damage to the pump and motor.

C. Submersible non-clog pumps shall be installed in a circular reinforced concrete wetwell. A separate precast reinforced concrete vault shall be provided for the gate valves and check valves as shown on the Plans.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01330 – Submittals

2. Section 01780 – Operation and Maintenance Data

1.03 SUBMITTALS

A. Comply with Section 01330.

B. Shop Drawings: Submit shop drawings for approval of the pumps and related equipment specified in this Section.

1. Certified shop and installation drawings and data regarding pump and motor characteristics and performance. Make, model, weight, and horsepower of each equipment assembly.

2. Detailed mechanical and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.

3. Factory tests reports.

C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and parts lists. Operation and maintenance manuals shall be provided according to Section 01780.

1.04 WARRANTY

A. Provide written warranty for a period of 2 years from the date of delivery of the equipment. For a period of two years after equipment delivery, the manufacturer shall, upon receipt of notice in writing from the Owner, promptly make all repairs or replacement of defective equipment.

1.05 PERFORMANCE REQUIREMENTS

Item	Underdrain Pump
Number of Pumps	1
Capacity (each), gpm	150
Total Dynamic Head, feet	35
Pump Speed, rpm	1800
Horsepower, maximum	5
Voltage/Phase	480/3
Minimum pump efficiency	60%

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCTS

A. Pumps shall be as manufactured by Yeomans, Flygt, or equal modified to meet the requirements of these specifications.

2.02 MATERIALS

A. Material employed for the construction of equipment provided under this specification shall be as follows:

Component	Material
Pump and Motor Casing	Cast iron, ASTM A48, Class 30 or 35
Discharge Elbow	Cast iron, ASTM A48, Class 35
Impeller	Cast iron, ASTM A48, Class 35
Motor and Pump Shaft	Stainless steel, ASTM A276, Type 431
Wearing Ring	Nitrile, ASTM A276, Series 400
Externals Bolts and Nuts	Stainless steel, ASTM A276, Type 304
Guide Bar Brackets	Stainless steel, ASTM A276, Type 316
Anchor Bolts	Stainless steel, ASTM A276, Type 316
Guide Rails, Lifting Chain and Hook Assemblies	Stainless steel, ASTM A276, Type 316

2.03 PUMP CONSTRUCTION

A. General

1. Pump stations shall be provided with the following accessories, installed as shown on the Plans or as recommended by the pump manufacturer:
2. Upper guide bar brackets.
3. Intermediate guide bar brackets.
4. Safety cable hooks.
5. Cable holders
6. Cable support grips.
7. Anchor bolts, Type 316 stainless steel.
8. Stainless steel lifting chain.

B. Mechanical Seals

1. Provide with tandem double mechanical seals running in an oil reservoir, composed of two separate lapped face seals.

   a. For the lower seal unit, between the pump and oil chamber, provide one stationary and one positively driven, rotating tungsten-carbide or solid block silicon-carbide ring, with each pair of rings held in contact by a separate spring.

   b. For the upper seal unit, between the oil sump and the motor housing, provide one stationary tungsten-carbide or solid block silicon-carbide ring and one positively driven tungsten-carbide ring.

   c. Ceramic and carbon lower seals are not acceptable.

   d. Provide seals that require neither maintenance nor adjustment and are easily replaceable.

   e. Make submersible pumps capable of continuous submergence without loss of watertight integrity to a depth of 65 feet.

C. Motors

1. Pump motor shall be housed in an air filled, watertight casting of NEMA B design and shall have Class H insulated windings, which shall be moisture resistant, and internal thermal switches. Pump motors shall be capable of continuous operation in a totally or partially submerged condition, including a minimum of 10 starts per hour without damage to the motor. The power cable shall be of adequate length to reach the furthest end of the motor control center plus ten feet. Provide motors with single cables of submersible pump application.

2. Three normally closed, automatic reset thermostats connected in series shall be embedded in adjoining phases of the stator windings. The thermostats shall be connected to safely shut down the motor upon opening.

D. Moisture Detection System

1. A dual probe moisture sensing system shall detect the entrance of moisture and provide an alarm. The moisture detection system shall be designed to detect the entrance of moisture in the stator and lower oil seal housing. The moisture sensing probe leads shall terminate at a conductance relay located in the control panel, which shall provide an alarm in the event of moisture intrusion.

E. Guide Rails

1. Guide rails and bases shall be an integral part of the pumping unit and the pump casing shall have a machined flange to connect with the discharge connection. Discharge connection shall be bolted to the floor of the wetwell and so designed as to receive the pump connecting flange without the need of any bolts, gaskets, or nuts. The guide rails shall be Schedule 40 stainless steel, 2 inches in diameter.

2. The cable entry shall have single grommet, washers, compressed by the entry body containing a strain relief function. The cable entry junction

chamber and motor shall be separated by a full terminal board. Epoxies or other secondary sealing systems are not considered acceptable.

F. Testing

1. As a minimum, each finished pump shall be performance tested at the factory for total dynamic head, capacity, efficiency and power requirements at six operating points plus shut-off head for the selected impeller diameter of which the design capacity operating point shall be included. All tests shall be run in accordance with the American Hydraulic Institute Standards.

2.04 ACCESSORIES

A. Check Valves

1. Ball check valves shall consist of three components: body, cover, and ball--one moving part. The design of the valve shall keep solids, stringy material, grit, rags, etc., moving without the need for back flushing. The ball shall clear the waterway providing “full flow” equal to the nominal size. There shall be no outside levers, weights, springs, dash pots, or other accessories.

2. Valve body and cover shall be of gray cast iron or ductile iron. Flange drilling shall be according to ANSI B16.1, Class 125. The valve ball shall be hollow steel with an exterior of nitrile rubber. It shall be resistant to grease, petroleum products, animal and vegetable fats, diluted concentrations of acids and alkalines (pH 4 to 10), tearing, and abrasion.

3. Ball check valves shall be Flygt HDL Type 5087, Golden Anderson Figure 240, or equal, modified to meet requirements specified in this section.

B. Gate Valves

1. Gate valves shall comply with AWWA C509 with bronze stem and stem nut; cast iron gate and body; styrene butadiene rubber resilient seat. Gate valves shall open with counter clockwise rotation of the handwheel.

C. Pump Access Hatch

1. Access hatches shall be Us Foundry Model APS 33 or equal have a minimum clear opening of 30-inch x 48-inch. Provide a single frame with one door leaf.

2. Door leaf shall be ¼ inch aluminum diamond pattern plate fabricated to with-stand 300 psf loading. Channel frame shall be ¼ inch structural grade aluminum cast into concrete slab.

3. Door shall be equipped with heave stainless steel hinges, stainless steel pins, compression spring operators for easy operation, and an automatic hold open arm with release handle. A snap lock with removable handle shall be provided. Mill finish with bituminous coating applied to exterior of the frame prior to embedment. Manufacturer shall guarantee proper operation and against defects in material and workmanship for a period of five years. The door shall be equipped with a covered, recessed padlock mechanism and shall be sized and reinforced as shown on the Plans to suitably accommodate the submersible pumps supplied.

4. A wetwell access “Safe Hatch” shall be provided and installed. The unit shall be designed to combine covering of the access opening per OSHA Standard 1910.23 and shall include fall through protection and controlled confined space entry.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Equipment and accessories shall be installed in accordance with approved written procedures submitted with the shop drawings, and as indicated on the Plans.

B. Align, connect, and install each pump in accordance with the manufacturer's written instructions.

C. Provide factory-trained personnel to check installation and test initial operation.

D. Certify installation and initial operation of all components.

3.02 MANUFACTURER’S FIELD SERVICES

A. The Pump system shall be tested for control and capacity over a 30-minute period. The Contractor shall furnish all labor, piping, equipment, pressure gauges and materials necessary for conducting the tests, including necessary clean water.

B. Provide field inspection and instruction services by factory-trained service technician of the manufacturer. Services by a sales representative are not acceptable.

1. Provide minimum 1 visit of 4 hours, excluding travel time, to inspect and test initial operation, and make necessary adjustments.

2. Provide minimum 1 visit of 4 hours, excluding travel time, to train plant operators.

****END OF SECTION****

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SECTION 11358

SUBMERSIBLE SUMP PUMP

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Single simplex submersible sump pump complete with motor, float controls, cable, and lifting handle. The pump shall be provided as specified and located in each sump as shown on the Drawings.

B. Type

1. Pump shall be of the submersible, centrifugal nonclog type for use in pumping floor drainage. Sump pumps shall be corrosion-resistant design.

C. Operating Requirements

1. Equipment provided under this section shall conform to the following:

Rated capacity, gpm	20 to 25
Design head, feet	25
Maximum speed, rpm	1,800
Voltage and phase	120/1
Maximum horsepower	0.4

1.02 SUBMITTALS

A. Submittals shall be provided in accordance with Section 01330.

PART 2 - PRODUCTS

2.01 ACCEPTABLE PRODUCTS

A. Pumps shall be as manufactured by Myers, Hydromatic, or equal, modified to provide the specified features and to the meet specified operating conditions.

2.02 MATERIALS

A. Corrosion-resistant pump shall be constructed with corrosion resistant bodies of Noryl GTX830, or comparable material, thermoplastic impellers, 316 stainless seal shaft and hardware, and Viton seals.

2.03 EQUIPMENT

A. Impeller

1. Impeller shall be statically and dynamically balanced and designed to be nonclog and to pass stringy material. Pump volute shall have vertical discharge.

B. Cable

1. Pump motor and detector cables shall be suitable for submersible pump applications.

2. Power for the motor shall be carried by a heavy-duty, flexible, water-resistant portable cable, sealed at the motor bell and of sufficient length to connect to the plug outlet as specified.

3. The cable entry shall prevent water from leaking into the motor due to capillary action even if cable is cut or damaged.

2.04 CONTROLS

A. Pump shall be controlled by an integral adjustable float control.

B. Piping

1. Exposed discharge Pipe: ASTM A53, Schedule 40, PVC. Valves: Globe; Crane 7TF or 17TF, Lunkenheimer 123 or 214, or equal.; Swing check; Lunkenheimer 230, Crane 137, or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Sump pump shall be installed in accordance with the manufacturer's recommendations.

END OF SECTION

SECTION 11375

AIR STRIPPER SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Provide a complete air stripper system as shown on the Drawings and as specified herein, capable of continuous operation and treatment of influent chlorinated raw well water for the removal of dissolved methane gas, to be processed separately downstream for potable use.

B. Provide the services of manufacturers' engineering representatives for construction support necessary to ensure that the Owner receives a completely integrated and operational air stripper system. Services shall include supervising startup testing, field pump calibration, O & M manuals, and operator training.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals
2. Section 09900 – Coating Systems
3. Section 11001 – General Equipment and Mechanical

1.03 SUBMITTALS

A. Submit a complete list of components, including manufacturer's descriptive and technical literature, capacities, make and model, materials of construction, catalog cuts, drawings, and installation instructions, performance charts, technical literature, and catalog cuts for packing, mist eliminator, stripper, valves, and instrumentation and controls. Also submit installation, operating and maintenance instructions as provided by the manufacturer, and field reports on completed installation, as provided by the manufacturer's representative.

B. Submit verification from a Registered Professional Engineer, registered in the state of California in which the system is to be installed, that the shell, ladder, platform, foundation anchorage, and lifting lugs were designed for the listed conditions in accordance with the appropriate requirements, codes and standards.

C. Submit operating instructions outlining the step-by-step procedures required for system startup, normal operation, short- and long-term deactivation, and shutdown. An introduction and overall equipment description, purpose, functions, and simplified theory of operation shall be included in the beginning of the instructions. The instructions shall include the manufacturer's name, model number, service manual, parts list and brief description of each piece of equipment and its basic theory and operating features. The instructions shall include piping and component layouts and wiring and control diagrams for the systems as installed. Performance test data shall be reflected in the operating instructions.

D. Submit maintenance instructions listing routine maintenance procedures, calibration procedures, possible breakdowns and repairs and troubleshooting guides. Procedures for cleaning and removal of scale and removal of fouling in packing media shall be included.

E. Submittal information in accordance with Section 01330 shall be provided for the following:

1. Product Data
2. Spare Parts Lists
3. Process Flow and Instrumentation Diagrams
4. Equipment Installation Instructions
5. Manufacturer’s Representative Qualifications
6. Design Calculations
7. Test Reports
8. Certificates of Proper Installation and Operation
9. Manufacturer's Instructions and Operation and Maintenance Data
10. Field Training

1.04 QUALIFICATIONS

A. Submit qualifications of the installer, supplier's representative, and for those listed in following subparagraphs.

1. Contractor: Contractor shall have a minimum of 5 years of experience in the construction of water or wastewater treatment facilities.
2. Supplier: The Contractor shall assign to a single supplier full responsibility for the furnishing of the air stripping system. The designated single supplier, however, need not manufacture the entire system but shall coordinate the design, assembly, installation, and testing of the entire system as specified herein.
3. Manufacturer's Representative: Provide the services of a manufacturer's field representative who is experienced in the installation, adjustment, and operation of the equipment furnished and who has complete knowledge of the proper operation and maintenance of the system. Submit names and qualifications of each manufacturer's field representative and training engineer with written certification from the manufacturer that each representative and trainer is technically qualified.
4. Welders (for steel aerator tanks only): Welding qualifications for welding procedures, welders, and welding operators shall be in accordance with Sections 8.2 and 8.8 of AWWA D100.

1.05 REFERENCE STANDARDS

A. The standards listed below are part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
AWWA C653	Disinfection of Water Treatment Plants
AWWA D100	Welded Steel Tanks for Water Storage
AWWA D102	Coating Steel Water Storage Tanks
AWWA D120	Thermosetting Fiberglass-Reinforced Plastic Tanks
ASME B40.100	Pressure Gauges and Gauge Attachments
NSF 61	Drinking Water System Components — Health Effects

1.06 DESIGN REQUIREMENTS

A. Environmental and Design Parameters

Requirement	Capacity or Range
Water Flow Rate, gpm	3,000
Water Temperature, deg-F	77
Ambient Air Temperature, deg-F	28 to 104
Ambient Air Temperature When Equipment is in Operation, deg-F	50 to 104
Air Stripper Tank Nominal Sidewall Height, ft maximum	18
Air Stripper Tank Nominal Diameter, ft	8 to 12
Vertical Projection Including Any Railing and Misc. Appurtenances (above concrete deck surface), ft maximum	20
Maximum Allowable Equipment Noise, dB	50

B. Influent Water Conditions

Criteria	Amount or Range
pH	7.9 to 8.2
Total Hardness as CaCO3, mg/L	14
Total alkalinity as CaCO3, mg/L	160
Hydroxide alkalinity as CaCO3, mg/L	Non-detect
Carbonate, mg/L	Non-detect
Bicarbonate, mg/L	160
Total Dissolved Solids, mg/L	280
Specific Conductance, µmhos/cm	395
Turbidity, NTU	1.3
Iron, mg/L	0.043
Manganese, mg/L	16
Calcium, mg/L	3.8
Magnesium, mg/L	1.1
Sodium, mg/L	73
Potassium, mg/L	3.7
Sulfate, mg/L	<0.5
Nitrate, mg/L	Non-detect
Chloride, mg/L	29.6
Fluoride, mg/L	0.48

A. Influent and Effluent Organic Contaminant Concentrations

1. Primary Treatment Contaminant: Methane

2. Influent Contaminant Concentration: 5.3 mg/L

3. Percent Contaminant Removal Required: 95%

B. Design Load and Seismic Requirements

1. The air stripper shell and components shall be structurally designed for seismic forces and loading requirements in accordance with the Design Criteria on Drawing GS-01. Structurally design the air stripper and appurtenances for the wind loads in accordance with the Design Criteria on Drawing GS-01, plus live and dead loads resulting from internally supported parts, weight of operating liquid when the shell is completely full of water, piping structural supports, and internal or external pressures with an appropriate safety factor.

2. Calculations and shop drawings shall be stamped and signed by a professional structural engineer registered in the state of California.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide materials and equipment, which are the standard products of a manufacturer regularly engaged in the manufacture of the products, and that essentially duplicate equipment that has been in satisfactory operation for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is reasonably convenient to the site.

B. Major equipment items shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Each piece of equipment shall bear the approval designation and the markings required for that designation. Valves shall be marked and shall bear a securely attached tag with the manufacturer's name, catalog number and valve identification permanently displayed.

2.02 AIR STRIPPER

A. The stripper system shall consist of one packed column air stripper to transfer volatile organic compounds out of solution from the influent water, and into the gaseous phase with air. Use manufacturer's standard size units whenever possible.

B. Shell

1. Construct the air stripper of fiberglass reinforced plastic (FRP) with ultraviolet (UV) inhibitors, 304 stainless steel, or steel with internal and external coating as specified, of suitable thickness to prevent deformation.

2. Steel tank materials shall conform to the applicable provisions of Section 2 of AWWA D100 or AWWA D120.

3. Design, fabrication, and erection shall be in accordance with the applicable requirements of AWWA D100 except as modified herein and in the design requirements of this specification.

4. Shop Fabrication shall conform [to Section 9 of AWWA D100 or AWWA D120.

5. Welding qualifications for welding procedures, welders, and welding operators shall be in accordance with Sections 8.2 and 8.8 of AWWA D100.

C. Internals: The air stripper internals shall be constructed of fiberglass reinforced plastic (FRP) or 304 stainless steel.

D. Packed Column: Furnish a packed column air stripper with the following features:

1. A column filled with packing material that has a large surface area to volume ratio.

2. The contaminated water is pumped to the top of the column above the packing and is distributed uniformly over the packing.

3. Air is forced up through the bed of packing at the same time the water is "trickling" down through the packing (i.e. countercurrent flow).

4. As the water and air pass each other, the volatile chemicals in the water leave the water (volatilize) and enter the air stream.

5. The air stream then carries the volatile chemicals up and out of the top of the column.

E. Packing

1. The column shall be filled with high efficiency open packing, either structured "arranged" or random "dumped" polypropylene, PVC, stainless steel, ceramic or other media that is durable under the service conditions.

2. Packing diameter shall not exceed 20 percent of the column diameter with the type of media supplied.

3. Packed section of the column shall be between 8 and 10 feet in diameter and the height of the packing shall be between 8 and 12 feet.

F. Packing Support

1. Packing support shall be fiberglass reinforced plastic or type 304 stainless steel.

2. If the bed depth exceeds the packing manufacturer's recommended maximum vertical depth of packing, an intermediate support shall be installed.

3. The support shall be of suitable thickness to prevent deformation when the packing becomes plugged and the entire shell above the packing support fills with water.

G. Water Distribution and Re-Distribution System

1. Water distribution system shall be type 304 stainless steel distributor tray that distributes the water over the fill area of the packing.

2. The distribution system shall be designed to allow for removal and replacement.

3. Water re-distribution systems shall be as recommended by the manufacturer.

4. Distance between re-distributors shall not exceed the maximum height span as recommended by the packing manufacturer.

H. Access, Manways, and Pipe Connections

1. The top of each column shall be bolted to provide access to tower internals from above. View ports shall be installed near the top and bottom of the column to check the water distribution and to check for fouling. The stripper shall be designed for easy removal of the packing.

2. Number, type, location, and size of manholes and pipe connections shall be as shown on the Drawings and as specified herein. Section 7 of AWWA D100 contains the minimum requirements for manholes and pipe connections. Flanged access ports 18 inch in diameter, shall be provided, shall be water and vapor tight, and able to withstand all loads and internal pressures during construction, operation, and cleaning. One or two access ports shall be at the top of the column for access to the mist eliminator and liquid distributor, and one shall be located near the bottom of the column to provide removal of the packing and packing support; and one shall provide access to the base.

3. Air stripper shall be piped to a concrete sump as shown on the Drawings. A 1/2 inch diameter minimum drain/sample port with manually operated ball or gate valve shall be provided at the bottom sidewall of the air stripper to allow drainage of the air stripper. The drain/sample port shall not be piped directly to the concrete sump.

I. Ladders, Platforms, and Cages

1. The air stripper shall be provided with a platform at the top of the column, and an access ladder. A platform shall provide access to each upper access port.

2. Provide catwalks, ladders, cages, and guardrails where indicated or required for safe operation and maintenance of equipment and in accordance with Sections 7.4 and 7.5 of AWWA D100.

3. Provision shall be made for the attachment of a scaffold cable support at the top of the roof on welded tanks.

4. Ladders shall have side rails and have non-slip rungs that are a minimum of 3/4 inches in diameter and 16 inches long.

5. The access ladder shall start at ground level. The distance between rungs shall not exceed 12 inches.

6. The ladder and platform shall bolt onto brackets that are welded to the columns, or shall be welded directly to the column.

7. Platforms shall be designed to support a uniform live load of 75 psf plus the dead load of the structure.

8. The platform shall be a minimum of 3 feet wide and fabricated from steel, aluminum, or fiberglass reinforced plastic. Grating openings shall have no dimension greater than 1 inch.

J. Lifting Lugs

1. Provide column and other major components with lifting lugs, as necessary for easy handling with a crane or similar device during installation, maintenance and replacement of column internals.

K. Support

1. Air strippers shall be free standing and supported entirely by anchoring to a concrete surface as shown on the Drawings and shall be compatible with the dimensional constraints indicated. A superstructure or frame not extending beyond the foundation will be permitted. No guy wires shall be used.

L. Anchorage:

1. Number of Anchors: An adequate number of anchors designed to prevent overturning of the stripper when in normal operation shall be installed. If anchor bolts are used, the nominal diameter shall be not less than 1 inch, plus a corrosion allowance of at least 1/4 inch on the diameter. If anchor straps are used, they shall be pre-tensioned before welding to the shell.

2. Anchor Bolts and Straps: Bolts shall be a right angle bend, hook, or plate washer, while anchor straps shall have only a plate welded to the bottom. The anchors shall be inserted into the foundation to resist the computed uplift.

3. Attachment: Attachment of anchors to the shell shall not add localized stresses to the shell in excess of the material tolerance. The method of attachment shall consider the effects of deflection and rotation of the shell. Attachment of the anchor bolts to the shell shall be via manufacturer approved anchor locations.

4. Seismic Requirements: Stripper tank and anchorage shall be designed to meet the requirements in accordance with the Design Criteria on Drawing GS-01.

2.03 BLOWER

A. Provide an air blower as part of the air stripper system. Blower shall be of the centrifugal fan type and shall be manufactured as a single complete unit.

B. Blower shall be suitable for operation under the environmental conditions listed below:

Requirement	Capacity or Range
Altitude, feet above mean sea level	30
Ambient Air Temperature, deg-F	28 to 104
Ambient Air Temperature When Equipment is in Operation, deg-F	50 to 104
Process Air	Ambient outdoor
Environment	Outdoors, covered

C. Performance:

Requirement	Capacity or Range
Design Capacity, cfm	As specified by air stripper system manufacturer
Pressure at Design Capacity, in H2O	As specified by air stripper system manufacturer
Nominal Horsepower, HP maximum	10
Maximum Allowable Equipment Noise (excluding acoustical enclosure), dB	105

D. Construction:

1. Fan Wheel: The fan wheel shall be of corrosion resistant fiberglass construction, statically and dynamically balanced. Fan wheel performance shall be non-overloading over the entire flow range of the blower.
2. Fan Housing: Housing shall be of steel or fiberglass construction. All fastening hardware shall be stainless steel.
3. Base & Pedestal: Base and pedestal shall be constructed using heavy gauge steel sheet or plate and steel structural members as designed and fabricated by the blower manufacturer.
4. Drain: A minimum 3/4” drain shall be provided at the lowest part of the housing, and shall be routed to the aeration sump using schedule 80 PVC pipe of the same diameter as the drain.
5. Drive: Pulley and shaft arrangement with V-belt drive and pulleys. Shaft bearings shall be sealed and lubricated self-aligning type ball bearings.
6. Motor: 480-volt, 3-phase, TEFC constant speed drive motor, no more than the maximum rated horsepower as specified.
7. Coating: Surfaces of the equipment and components shall be factory coated by the manufacturer according to the requirements in Section 09900. Threaded surfaces, keys, and keyways shall not be painted.
8. Fasteners: All fasteners installed at locations subject to vibration when the blower is in operation shall be provided with lock-washers, locknuts, or other suitable anti-loosening hardware to prevent equipment vibration from loosening fasteners during equipment operation.
9. Anchorage: Anchorage for mounting the equipment base to the concrete surface as shown on the Drawings shall be designed by the blower manufacturer and shall meet the requirements as specified in Section 11001

E. Spare Parts: Provide spare parts as recommended by the blower manufacturer, including, but not limited to the following:

1. Two (2) spare replacement V-belts for two (2) complete belt changes.
2. One (1) spare set of all bearings/bushings.
3. Any lubricants, including grease or oil as required for four (4) complete lubrication changes.

4. One (1) spare set of any keys for keyways as required.

5. One (1) spare set of any specialty fasteners as required.

F. Manufacturers, or equal:

1. Viron International, Inc.

2. Cincinatti Fan

2.04 MIST ELIMINATOR

A. The mist eliminator shall have the minimum separation efficiency stated in the performance requirements. Materials shall be as specified for the stripper internals.

2.05 OFF-GAS CONTROL

A. No treatment of off gas from the air stripper column is required.

2.06 INSTRUMENTATION AND CONTROLS

A. Instrumentation and controls shall conform to the requirements of Division 17 and the requirements specified for each piece of the equipment with the interlocks and control devices specified herein.

1. Gauges shall have 4 inch dials, shall be stem mounted, and shall conform to ASME B40.100. Accuracy of gauges shall be Grade A or better. Gauges shall be calibrated in psi in not more than 2 psi increments from 0 to 50 psi in excess of the normal operating pressure at the tank.

2. Control to shut down the system and activate an alarm if the blower fails.

3. Interlock for concurrent operation of blowers and well pump run status input from the Plant PLC.

4. Direct reading pressure gauge in the air inlet throats.

2.07 MISCELLANEOUS HARDWARE

A. All internal fastening hardware and anchoring hardware shall be type 316 stainless steel. All external hardware, with the exception of anchoring hardware, shall be galvanized or plated steel.

2.08 SPARE PARTS

A. Provide spare parts for each different item of material and equipment specified, including all parts recommended by the manufacturer to be replaced after 1 year of service. Submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and contact information from a local source of supply. Provide all special tools and devices required for periodic maintenance, repair, adjustment, and calibration.

2.09 MANUFACTURERS, OR EQUAL

A. Viron International, Inc.

B. Carbonair

PART 3 - EXECUTION

3.01 EXAMINATION

A. The Contractor remains responsible for ensuring proper fitment, and shall verify the dimensions of all manufacturer equipment, piping, and field dimensions prior to performing the work.

3.02 EQUIPMENT INSTALLATION

A. Install equipment as shown and in accordance with the written instructions of the manufacturer, under the direct supervision of the manufacturer's representative, and in accordance with the applicable provisions of Section 10 of AWWA D100 or Section 7 of AWWA D120. Submit drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

B. Anchor bolts, nuts, and washers shall be Type 316 stainless steel and shall be cast in place during concrete placement. Threads shall be protected and shall be cleaned before the nuts are installed and tightened.

3.03 PAINTING

A. Welded Tanks

1. Exterior Surfaces: The paint system applied to the outside of the tank air stripper shall be NSF 61 certified for use with potable water systems, and in accordance with Section 09900. Factory primed surfaces shall be solvent-cleaned before painting. Surfaces that have not been factory primed shall be prepared and primed in accordance with the paint manufacturer's recommendations.

2. Interior Surfaces: Tank interior surfaces shall be coated in accordance with Sections 3.2, 3.3, 3.4, 3.5, 3.6 or 3.7 of AWWA D102.

B. Touch-up Painting: Factory painted items shall be touched up as needed. These items shall be cleaned of all foreign material and shall be primed and top coated with the manufacturer's standard factory finish.

C. Field Painting: Equipment which did not receive a factory finish shall be painted as specified in Section 09900.

D. Corrosion Resistant Metals: Painting of corrosion resistant materials such as copper, brass, bronze, copper-nickel, and stainless steel shall not be performed unless otherwise specified.

3.04 MANUFACTURER FIELD SERVICES

A. Prior to startup, the equipment shall be inspected for alignment and connections by a factory representative. The manufacturer's representative shall inspect the final installation and supervise the adjustment and testing of the equipment. The manufacturer's representative shall demonstrate that the system meets the performance requirements.

3.05 TESTING

A. Hydrostatically test the aerator tank column prior to the installation of packing by completely filling the shell with water and inspecting for leaks. Repair leaks and retest the column. Check equipment for leaks after it has been filled for at least one hour. Shell inspections and testing shall be in accordance with Section 11 of AWWA D100. Mill and shop inspections shall be performed by an approved commercial inspection agency. Perform the hydrostatic test and the vacuum box leak test of the tank bottom. Final leak test and hydrostatic test shall be performed before any field painting required.

3.06 ADJUSTING, CLEANING, AND DISINFECTING

A. Make adjustments within the control range to obtain optimum performance under actual field conditions. Cleaning and disinfection in accordance with AWWA C653 are required prior to placing the aeration system in service.

B. Performance Testing

1. Inspect and test all equipment under operating conditions after installation. Demonstrate the unit to run without operator intervention for a minimum of 36 contiguous hours. If inspection or test shows defects, such defects shall be corrected, and inspection and test shall be repeated.

2. Submit performance reports according to Section 01330 upon completion of testing of the installed system. Test reports shall include all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of all controls. Performance test data shall be reflected in the operating instructions.

3. Operate each unit at the maximum flow specified in the performance requirements for at least one hour prior to sampling. Submit performance reports according to Section 01330 upon completion of testing of the installed system. Collect a minimum of two influent and two effluent samples while the system is in operation and in the presence of the Engineer, and transport the samples to an independent water quality testing laboratory for analysis of the primary treatment constituent as specified. Submit laboratory reports of the laboratory test results of the samples.

4. Removals shall meet or exceed the specified system performance requirements. If the results of the laboratory analyses of the influent and effluent water indicate that the air stripping system is not in compliance with the Contract Documents, the Contractor shall make repairs or modifications as required at the Contractor's expense. Additional laboratory tests shall be performed as required until the specified system performance requirements are met, at the expense of the Contractor.

3.07 STARTUP

A. After completion of all testing, the manufacturer's representative shall schedule two (2) consecutive 8-hour days to assist the plant operators in plant startup.

3.08 TRAINING

A. Conduct a training course covering the operation and maintenance of all components of the system for the Owner's operations staff. The training shall be performed on one (1) 8-hour day, and shall cover the topics included in the Operating and Maintenance Manuals. Submit training course curriculum and training instructions, 14 days prior to the start of training. Training shall be held after the completion of all acceptance tests.

END OF SECTION

SECTION 11550

ACOUSTICAL ENCLOSURES FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

A. Contractor shall furnish all materials, equipment, labor and incidentals necessary to furnish and install acoustical enclosures for mechanical equipment as shown on the Plans and as specified herein.

B. Acoustical enclosures for mechanical equipment shall be insulated double-wall construction, suitable for outdoor exposure, and shall be provided by a recognized manufacturer with published standards of construction and technical performance. The manufacturer shall have produced a standard factory-fabricated panel system and components for at least 5 years.

1.02 CONTRACTOR RESPONSIBILITY

A. The Contractor shall coordinate between the acoustic enclosure manufacturer and the mechanical equipment manufacturer to ensure the acoustical enclosure is designed with adequately sized and appropriately located sound attenuating ventilation louvers as part of the acoustical enclosure.

B. The Contractor shall coordinate between the acoustic enclosure manufacturer and the mechanical equipment manufacturer to ensure the installed acoustical enclosure does not prohibit access to portions of the mechanical equipment which would otherwise prevent routine maintenance from being performed.

C. The Contractor remains responsible for ensuring adequate ventilation and accessibility for the mechanical equipment housed within the enclosure is obtained, and must perform the necessary modifications to the enclosure until such requirements are met. Modifications performed by the Contractor shall be as recommended by the enclosure manufacturer, and must result in a final installation which meets all requirements as described herein, and does not void any warranty of the enclosure or the mechanical equipment within.

1.03 SUBMITTALS

A. Prepare submittals in accordance with Section 01330. Complete assembly and installation drawings, together with detailed specifications and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished, shall be submitted. The data and specifications for each enclosure shall include, but shall not be limited to, the following.

1. Assembly and installation drawings including plan and section drawings, assembly details, anchorage details, part nomenclature, material list, outline dimensions, loading/unloading and handling requirements, and shipping weights.

2. Complete dimensional drawings for all enclosure components. Coordinate equipment dimensions with the dimensional requirements as shown on the

Drawings and as specified. Submit anchorage calculations meeting the requirements of Section 05501.

3. Acoustical performance data.

4. Coating materials, product data sheets on each type of paint and primer, and application instructions.

PART 2 - PRODUCTS

2.01 GENERAL

A. Acoustical Enclosures

1. Provide acoustical enclosures for mechanical equipment according to the following:

Mechanical Equipment	Design Sound Pressure Level of Equipment, dBA (1)	Maximum Allowable Sound Pressure Level w/ Acoustic Enclosure in Place, dBA (1)
Deep Well Vertical Turbine Pump (Refer to Section 11301)	80	73
Raw Water Booster Vertical Turbine Pump (Refer to Section 11302)	68	60
Aeration System Blower (Refer to Section 11375)	105	71
(1) All sound pressure levels measured at 3-feet from the perimeter of the equipment at any location around the equipment.		

2.02 MATERIALS OF CONSTRUCTION

A. Acoustical Panels

1. All panels and their components shall be pre-fabricated, sectional, all metal-clad, modular, and designed for easy and accurate field assembly. The panels and components shall not be susceptible to damage due to extended exposure to vibration, air temperature or humidity.

2. All panels shall be minimum 2-1/2 inches thick, with a solid galvanized steel Type G90 exterior shell and a perforated/solid galvanized steel type G90 interior shell. The panels shall be connected together by means of a tongue and groove connection and held together rigidly by the use of self-drilling corrosion resistant sheet metal screws.

3. The panel shell framing members and internal reinforcements shall be welded, screwed and/or riveted together to form a metal-sheathed panel of sufficient strength for maximum operating loads specified in the structural requirements section of these specifications.

4. The solid exterior outer galvanized steel shell thickness shall be 18 ga. minimum and the interior perforated galvanized steel shell shall be 22-ga. minimum thick.

5. Where perforated materials are indicated, all perforations shall be 3/32" dia. holes on 3/16" staggered centers and shall result in an open area of no less than 23 percent.

6. All panel internal and external reinforcing members shall be minimum 18 gauge galvanized steel.

7. Each panel shall be filled with sound-absorbing materials that are inert, mildew-resistant, vermin-proof, and incombustible.

B. Panel Trim Components and Installation

1. All accessory trim items shall be of 18 ga. minimum galvanized steel and shall be furnished in factory-standard lengths to be field cut to specified dimensions.

2. Location and quantity of sheet metal screws and trim requirements shall be in accordance with the manufacturer's installation details.

3. For enclosures around all mechanical equipment mounted on a concrete pad or slab, base channel shall be installed on a level and structurally sound surface on the concrete, utilizing adhesive anchors.

4. For enclosures around concrete pedestal mounted vertical well pumps, all mechanical equipment mounted on a concrete pad or slab, base channel shall be installed level around the perimeter of concrete well pedestals with adhesive anchors, utilizing channels and brackets as required and as recommended by the enclosure manufacturer to support the base channel to the sides of the concrete well pedestal, below the top surface of the well pedestal and exposed piping.

5. A minimum clearance of 3" shall be provided between the inner surfaces of the enclosures and enclosure framing members, and the outer surfaces of the equipment at all locations.

6. All external panel connectors, trim items, accessories, base channel/panel interfaces/base channel/floor interfaces, and other sections as noted on the drawings shall be sealed with an acoustical sealant that shall not harden and prevent disassembly in the future.

2.03 PERFORMANCE

A. Requirements

1. Enclosures shall be meet the standards and loading conditions as specified under Design Criteria on Drawing GS01.

2. Under the indicated loading conditions, the entire enclosure system shall be self-supporting and/or will be supported as per the specifications.

3. The installer shall furnish and assemble all structural members in strict accordance with drawings and manufacturer's installation details.

4. Under the above loading conditions, the assembled acoustical structure shall not exhibit any panel joint deflection in excess of L/240, where L is the unsupported span length of any panel section in the erected structure.

5. The manufacturer shall provide certified testing data indicating sound absorption and transmission loss characteristics of the panel assembly.

2.04 MANUFACTURER

A. Acoustical enclosures shall be provided by one of the following manufacturers, or equal:

1. eNoise Control
2. Kinetics Noise Control
3. Phoenix-E, SonoCon

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install acoustical enclosures in strict conformance with manufacturer's installation instructions. Completed acoustical enclosure installations shall be tightly assembled and free of resonance or audible buzzing when equipment within is in operation.

B. Install acoustical enclosures to retain the minimum clearances specified between the inner surfaces of the enclosures and enclosure framing members, and the outer surfaces of the equipment at all locations.

C. ANCHOR BOLTS

1. Anchor bolts shall meet the requirements of Section 05501.
2. Accurately place anchors using templates.

3.02 FIELD PAINTING

A. Field repair any areas which exhibit damage to the factory applied coating in accordance with Section 09900.

3.03 TESTING

1. Conduct sound tests with acoustical enclosures installed and with equipment within in operation throughout their full normal operating ranges.
2. Each installation shall not develop sound levels in excess of maximum allowable limits as specified.
3. If noise in excess of the limits specified is exhibited, adjust or modify as necessary. Acoustical enclosures which cannot be adjusted or modified to conform as specified shall be replaced.

END OF SECTION

SECTION 13100

CATHODIC PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work necessary to furnish all materials, install all equipment and provide all labor necessary to complete the work shown on the Plans and or/listed below and all other work and miscellaneous items not specifically mentioned but reasonably inferred, including all accessories and appurtenances required for a complete cathodic protection system. The intent of this specification is to provide for a complete, functional cathodic protection system.

B. Work included in this section consists of all components of the cathodic protection system; including anodes, cables, test stations, insulating joints, and any other work necessary to complete the installation. Work on this project includes the following items:

1. Bonding of flanges, flexible couplings, and other non-welded, non-insulating fittings.
2. Trenching and other excavation.
3. Installation of insulating joints and test stations.
4. Backfill and compaction of backfill.
5. Provide shop Plans, reports, permits, and obtain Owner's approval where required.
6. Correction of all deficiencies.
7. The work shall include the provision of all materials, equipment, and apparatus not specifically mentioned herein or noted on the plans, but, which are obviously necessary to complete the work specified.

1.02 REFERENCED SECTION

A. The following Section are referenced in this Section:

1. Section 01330 – Submittals

1.03 SUBMITTALS

A. Submittals shall comply with Section 01330, and shall demonstrate full compliance with all aspects of this specification, and shall include the following: A complete list of corrosion control equipment and material, including name and manufacturer, catalog number, size, finish and any other pertinent data necessary for proper identification and to determine conformance with specifications. These items include but are not limited to:

1. Cables
2. Cable Terminations

3. Exothermic Welding Equipment and Supplies
4. Cable-To-Pipe Coating Material
5. Traffic Boxes
6. Terminal Boxes, and Hardware
7. Cable Warning Tape
8. Cable Identification Tags
9. Insulating Flange Kits

1.04 REFERENCE STANDARDS

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of a conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

1. American Society of Testing and Materials (ASTM)
2. National Electrical Manufacturers Association (NEMA)
3. Industrial Cable Engineers Association (ICEA)
4. American Water Works Association (AWWA)
5. National Association of Corrosion Engineers (NACE)
6. American National Standards Institute (ANSI)

1.05 CODES AND REGULATIONS

A. All materials, workmanship, and installation shall conform to all requirements of the legally constituted authority having jurisdiction. These authorities include, but are not limited to, the latest revision of the State of California, Department of Industrial Relations, Division of Industrial Safety Orders of the Industrial Accident Commission, and all other applicable State, County, or City codes and regulations. Nothing in the Plans or specifications is to be construed to permit work not conforming to these regulations and codes. Where larger size or better grade materials than required by these regulations and codes are specified, the specifications and Plans shall have precedence.

PART 2 - PRODUCTS

2.01 GENERAL

A. All materials shall conform to the requirements set forth herein or as designated on the Plans, unless otherwise specified. All materials must be new, free from defects, and shall be of the best commercial quality for the purpose specified. The Contractor shall furnish all necessary items and accessories not shown on the Plans or specified herein, but which are required to fully carry out the specified intent of the work, without additional cost to the Owner.

2.02 CABLES

A. All underground cables utilized for bonding cables shall be single conductor, stranded copper, Type CP, insulated for 600 volts with High Molecular Weight Polyethylene (HMWPE) in accordance with the requirements of ASTM D 1248, Type 1, Class C, Grade 5 and ICEA NEMA S 61 402.

B. All cables for anodes and test stations (except AC mitigation test stations) shall be Type THHN, stranded, copper, sized as shown on the Plans, conforming to Federal Specification J-C-30.

C. All cables for test stations, anode header cables and zinc anodes shall be Type RHW-2/USE-2 stranded, copper, sized as shown on the Plans and shall conform to Federal Specification J-C-30. Cables shall be color coded as shown on the Plans.

D. Cable Insulation Color for Anodes and Test Stations

E. Pump Station Pipe: White

F. Tank-side, Non-Project or Foreign Pipe: Red

G. Transmission Pipeline: Striped

2.03 CABLE-TO-PIPE CONNECTIONS

A. The cable connections to the pipelines shall be accomplished utilizing an exothermic welding process as shown on the Plans. Each cable shall be fitted with a copper sleeve for accomplishing the weld and cartridge, sleeves and molds for each weld shall be furnished by the same manufacturer. All materials for welding shall be sized and in accordance with recommendations in manufacturers' literature.

B. Manufacturers, or equal

1. “Cadweld" by Erico Products, Inc.
2. "Thermoweld" by Continental Industries, Inc.

2.04 CABLE-TO-PIPE COATING MATERIAL

A. Cement Coated Pipe

1. Epoxy shall be used for sealing the cable-to-pipe connections.
2. Manufacturers, or equal
   a. Durcon-164, by Duriron Company
   b. Scotchcast Resin No. 4, by 3-M Company
   c. CC-1 Potting Compound, by PSI Products.

B. Mortar Coating Repair

1. Non-shrink cement mortar.

2.05 FLUSH GRADE TEST STATION

A. Flush grade test stations shall be traffic boxes with cast iron cover as shown on the Plans. Terminal boxes shall be locking type, constructed of high-impact, molded Lexan plastic. The test box shall be provided with sufficient hardware and terminals for each cable as shown on the Plans. All test station hardware, including nuts, bolts and shorting straps shall be nickel plated brass

B. Manufacturers, or equal

1. Traffic Valve Box: Christy G12 traffic box or approved equal.

2. Valve Box Covers: Cast iron, with legend “CP TEST” as indicated on Plans.

3. Terminal Boxes

a. Terminal boxes at tank valves shall be locking type, constructed of high-impact, molded Lexan plastic, Model "Big Fink", as manufactured by Cott Manufacturing Company or approved equal. The test box shall be provided with sufficient hardware and terminals for each cable as shown on the Plans. All test station hardware, including nuts, bolts and shorting straps shall be nickel-plated brass.

b. Terminal Boxes at the connection of the pump station piping to the ductile iron transmission pipelines: The junction box shall be constructed of molded fiberglass and shall be for service as required by NEMA 4X standards. The junction box shall be furnished with a stainless steel continuous piano hinge and stainless steel luggage latches with padlock hasp. All conduit entrances shall be drilled to accommodate a water tight conduit hub. The conduit entry shall be made watertight by epoxy encapsulation as shown on the Plans. The junction box shall have a phenolic panel board with the nickel plated brass bolts, nuts and washers, dead-front terminals, shunts, etc. as shown on the Plans.

2.06 CABLE WARNING TAPE

A. All buried test station cables shall have plastic warning tape installed a minimum of 12 inches above the top of the cables for the entire buried length of the cables. The warning tape shall be 4 inch wide and shall be yellow with black lettering with the legend "CAUTION, CATHODIC PROTECTION CABLES BURIED BELOW" in 3 inch high lettering printed at a minimum of seven foot intervals along the entire buried length of the cable.

2.07 CABLE IDENTIFICATION TAG

A. All cables in the terminal boxes shall be identified. The identification tags shall be white plastic "zip-tie" type straps with a plastic tab of sufficient size to allow the pipeline station to be written on the tab with a permanent felt tip marker.

2.08 INSULATING FLANGED JOINTS

A. Insulating Flexible Coupling

1. A double boot assembly shall be installed on the flexible coupling to electrically isolate the water pipeline from existing pipelines.

B. Insulating Flange

1. Each insulating flange set shall consist of a full-face central gasket, a full-length sleeve for each flange bolt, and two insulating washers with two steel washers for each bolt. The ring-type central gasket shall be 1/8-inch thick sheet packing, having a dielectric constant of 300 volts per mil, minimum. Bolt sleeves shall be fabric reinforced phenolic resin or mylar, and insulating washers shall be constructed of fabric reinforced phenolic resin. The complete assembly shall have an ANSI pressure rating equal to that of the flanges between which it is installed.

C. Insulating Flanged Coupling Adapters

1. Insulating elements shall be installed to electrically isolate the water pipeline from existing pipelines. The insulating elements shall consist of a full-face central gasket, two sleeves for each end of the flange bolt, and two insulating washers with two steel washers for each bolt. The gasket shall be 1/8-inch thick sheet packing, having a dielectric constant of 300 volts per mil, minimum. Bolt sleeves shall be fabric reinforced phenolic resin or mylar, and insulating washers shall be constructed of fabric reinforced phenolic resin. The complete assembly shall have an ANSI pressure rating equal to that of the flanges between which it is installed.

2.09 BURIED INSULATING JOINT COATING MATERIAL

A. Coatings for buried insulating flanges and insulating couplings, etc, shall consist of a non-conductive, petrolatum-based coating system. The coating system shall consist of a prime coat as an initial surface preparation to displace moisture on the surface and to improve adhesion of the wax tape. A wrap material shall be used to provide a smooth contour on the surface of the joint as well as for protection of the substrate. An over wrap shall be used as a final coating to provide increased mechanical strength of the coating. The prime coat shall be a petrolatum material with corrosion inhibitors and plasticizers. The wrap coat shall be a synthetic fabric saturated with a blend of petroleum wax, plasticizers and corrosion inhibitors. The over wrap shall be plasticized, self adhesive PVC tape.

B. Manufacturers, or equal

1. Trenton Wax Tape #1 by the Trenton Corporation

PART 3 - EXECUTION

3.01 MATERIAL DELIVERY, STORAGE AND PROTECTION

A. All materials and equipment to be used in construction shall be stored in such a manner to be protected from detrimental effects from the elements. If warehouse

storage cannot be provided, materials and equipment shall be stacked well above ground level and protected from the elements with plastic sheeting or other method as appropriate.

3.02 GENERAL

A. All materials, workmanship and installation shall conform with all requirements of the legally constituted authority having jurisdiction. These authorities include, but are not limited to, the latest revision of the State of California, Department of Industrial Relations, Division of Industrial Safety, Electrical Orders; The National Electric Code, General Construction Safety Orders of the Industrial Accident Commission; and all other applicable State, County, or City codes and regulations. Nothing in the Plans or specifications is to be construed to permit work not conforming to these regulations and codes. Where larger size or better grade materials than required by these regulations and codes are specified, the specifications and Plans shall have precedence.

3.03 CABLES

A. Cables buried in the ground shall be direct buried and shall be laid straight, without kinks. The cable shall have a minimum cover of 30 inches. Each cable run shall be continuous in length and free of joints or splices. Care shall be exercised during installation to avoid punctures, cuts, and similar damage to insulation. Any damage to insulation will require replacement of the entire cable length. Backfill surrounding the cables shall be native soil free of foreign materials. Cable warning tape shall be installed 12-inches above the entire buried length of the cable.

3.04 CABLE-TO-PIPE CONNECTIONS

A. Cable-to-pipe connections shall be installed in the manner and at the locations shown on the Plans. Coating materials shall be removed from the pipe surface over an area just sufficient to make the connections. The surface shall be cleaned to white metal by grinding or filing prior to welding the conductor. Grinding with resin impregnated wheels shall not be allowed. The conductor shall be welded to the pipe by the exothermic process with a copper sleeve fitted over the conductor, and only sufficient insulation shall be removed from the conductor to allow placing in welding mold. After the weld has cooled, all slag shall be removed and the weld shall be tested with a sharp blow from a 22 ounce hammer to assure proper metallurgical bond. All defective welds shall be removed and replaced. All exposed surfaces of copper and steel shall be covered with a minimum thickness of ¼ inch of insulating materials as shown on the Plans. Where shown on the Plans, the connection shall be made by welding a prefabricated rod and cable assembly to the pipeline at the pipe joints.

3.05 TEST STATIONS

A. Test stations shall be installed at locations designated on the Plans and at all anode installation locations. The test station shall be located in the sidewalk or the edge of the road for easy accessibility and good drainage. Exact locations of test stations shall be determined by the OWNER in the field. The terminal end of each cable shall be identified with the structure identification using the permanent cable

identification tags. All cables shall be terminated utilizing heavy duty tinned copper, compression type ring terminals. An approved crimping tool shall be utilized.

B. The test station leads shall be tested by the CONTRACTOR and results approved by the OWNER prior to backfill.

3.06 JOINT BONDING

A. All non-insulating, non-welded rubber gasket joints, mechanical joints, flange joints and threaded joints (including inter-ties and fire hydrant laterals) shall be bonded with a insulated copper cable, sized as shown on the Plans. The overall length of the conductor shall permit maximum movement of the pipe joint without transferring any tensile stress to the cable, per pipe manufacturer's recommendations.

B. No bond cables shall be installed on insulating joints.

C. The bonded pipe sections shall be tested for continuity, prior to backfilling. Total resistance of the bond or bonds at each joint shall not be greater than 120 percent of the linear resistance of a pipe section. The resistance of each bonded section of pipe shall be tested by circulating current in the subject section.

3.07 INSULATING FLANGED JOINTS

A. All insulating components of the insulating flanged gasket set shall be cleaned of all dirt, grease, oil and other foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. After flanged bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved ohmmeter, and the minimum resistance shall be 50,000 ohms. Where the insulating joint is assembled in the shop and shipped as a unit, resistance shall be measured in the shop between the flanges and between each bolt and flange and shall meet the above requirements. All insulating flanged joints shall be coated as shown on the Plans and specified below.

B. The testing shall be conducted in the presence of the OWNER's representative and approved by him prior to backfill.

3.08 COATING INSULATING FLANGED JOINTS AND HARNESS SETS

A. Surfaces shall be cleaned of all dirt, grease, oil and other foreign materials immediately prior to coating. Remove loose rust, paint and other foreign matter in accordance with SSPC SP2 or SP3. A prime coating shall be applied in a uniform coating over the entire surface to be wrapped. A liberal coating shall be applied to threads, cavities, shoulders, pits and other irregularities. A fill coating shall be molded and packed onto irregular surfaces such as flanges, valves or flexible couplings to create a smooth profile prior to wrapping. A wrap coating shall be spirally wrapped using a minimum of 55 percent overlap to ensure a double thickness of material. At the completion of each roll the overlaps shall be smoothed by hand in the direction of the spiral to ensure sealing of the overlap. A

2-inch overlap shall be maintained when overlapping one roll with the end of a new roll. Overlap shall occur on the top half of the pipeline. A guard coating shall be spirally over-wrapped using a 55 percent overlap to ensure a double coating.

3.09 SYSTEM COMMISSIONING

A. After installation of the cathodic protection facilities, the system shall be tested, and adjusted by the CONTRACTOR's corrosion engineer, witnessed by the OWNER, to assure conformance with the specifications. Testing shall include a determination of proper installation of each component, adequacy of test stations and insulating joints, and electrical continuity of bonded pipe fittings. All insulating flanges shall be tested with a flange insulation tester such as Gas Electronics Model 601, or equal prior to backfilling. All bonded pipe sections shall be tested for electrical continuity prior to backfilling. Upon completion of tests, a detailed report will be submitted describing any deficiencies detected. Any and all deficiencies shall be corrected by the CONTRACTOR and site conditions restored prior to final acceptance. All retesting shall be at the CONTRACTOR's expense.

B. The CONTRACTOR shall notify the OWNER 48 hours prior to installation of any cathodic protection components so that inspections can be scheduled. Phone messages left with others will not be considered adequate notification. The CONTRACTOR shall not backfill any cathodic protection components prior to inspection and approval by the OWNER.

3.10 QUALITY ASSURANCE

A. All work shall be performed to the satisfaction of the OWNER.

B. The CONTRACTOR shall not substitute for the specified materials unless approved by the OWNER.

C. Compaction of backfill and trenches shall match the existing conditions and shall be approved by the OWNER.

D. Interference and Exact Locations

E. The CONTRACTOR shall coordinate and properly relate this work to the site and to the work of all trades. The general locations of the facilities are shown on the Plans. However, the CONTRACTOR shall visit the premises and thoroughly familiarize himself with all details of the work and working conditions, verify existing conditions in the field, determine the exact locations of existing pipelines and structures and advise the OWNER of any discrepancy that may prevent or hinder the specified work from being completed. The CONTRACTOR shall be solely responsible for location and marking underground structures so as to avoid damage during construction.

END OF SECTION

SECTION 13200

SIGNAL REPAIR

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This work shall include the furnishing of all labor, materials, tools and equipment to restore and replace all traffic signal systems damaged or otherwise disturbed by Contractor. Restoration, materials, and workmanship shall be in accordance with these specifications, the City, County, and State Standard Plans.

B. Replace all material and components equal to or better than existing in quality and function, and as required by the latest codes, rules and regulations of state and local codes and ordinances, National Electrical Code, and Uniform Building Code. All replacement materials shall be new. Reuse of existing materials shall not be permitted unless otherwise approved by the Engineer.

1.02 SIGNAL RESTORATION CONTRACTOR QUALIFICATIONS

A. All work in connection with the traffic signal restoration and replacement including restoration of traffic detection loops shall be performed by experienced electrical contractor which has at least ten years' experience and whose record of experience and quality of work are satisfactory to the City and County. The Contractor must have previously constructed a minimum of three traffic signalizations. The Contractor shall hold a current C-10 state contracting license, and supply prior to beginning work proof of the license and a list of references of previously constructed projects.

1.03 QUALITY CONTROL

A. Materials, Installation, and Standards shall comply with Section 86 of the State Standard Specifications and these special provisions.

B. The Contractor shall be responsible for all work and materials and/or equipment installed under these Plans and Specifications.

C. The Contractor shall repair or replace at his expense, any defective work, material, or equipment which may become evident within one year of the date of filing of the Notice of Completion. The Contractor shall be responsible for all damage to other materials, equipment, structures, etc., caused by defects for a one-year period if the defect is due to defective material, equipment or workmanship.

D. If any part (or parts) is found to be defective in materials or workmanship within the one year period, and it is determined by the Engineer or by an authorized manufacturer's representative that said part (or parts) cannot be repaired on the site, the manufacturer shall provide a replacement part (or parts) of equal kind and/or type during the repair period, and shall be responsible for the removal, handling, repair or replacement, and reinstallation of the part (or parts) until such time as the traffic signal equipment is functioning as specified and as intended herein, the repair period shall in no event exceed 8 hours, including acquisition of parts.

E. The one-year guarantee on the repaired or replaced parts shall again commence with the date of reassembly of the system.

1.04 INTERRUPTION OF EXISTING UTILITIES

A. The Contractor shall bear the cost of any utility interruption, temporary relocation, modification, or other modifications as needed to remove and restore any traffic signal component4

PART 2 - PRODUCTS

2.01 CONDUIT

A. Conduit shall be rigid galvanized metal.

B. When a standard coupling cannot be used for coupling metal-type conduit, a UL listed threaded union coupling shall be used, as specified in Section 86 2.05C, Installation of the State Standard Specifications.

C. Insulated bonding bushings will be required on metal conduit. All conduit shall be grounded together in all pull boxes and cabinets by means of a grounding jumper.

D. Conduit to be installed under pavement shall be installed by bore and jacking, directional drilling, or other approved methods which do not damage pavement.

E. After conductors have been installed, the ends of conduits terminating in pull boxes, and in service and controller cabinets shall be sealed with an approved type of sealing compound.

2.02 PULL BOXES AND HANDHOLES

A. Pull boxes shall be pre-cast reinforced concrete with “Traffic Signal” or “Service” stamped on lids. Handholes shall be Type A.

B. Pull boxes shall be State Standard #5 minimum. Larger sizes shall be installed where required by the National Electrical Code or Engineer. The bottoms of pull boxes shall be grouted.

2.03 DETECTORS

A. Loop wire shall be Type 1 conform to Section 86-2.08 of the State Standard Specifications for Type 1 loops. Detector loops shall be Type 4A per Caltrans Standard Plans ESd 5A and ES 5B. Unless shown otherwise, each loop shall consist of three turns of loop conductor. Conductor of each loop shall be run continuous, without splice, to the termination pull box where splice to detector lead-in cable is made. Conductors from loop to termination pull box shall be twisted together three turns per foot, before inserting in the saw cut slot and conduit. Each loop shall be installed with the conductor wound in a clockwise rotation. Each individual conductor shall be banded "Start" and "End" in the termination pull box.

B. Each pair of loop conductors shall be identified and banded together in pairs, by lane, in the termination pull box. A minimum of five feet of loop conductors shall be provided, after splicing, in a termination pull box. All banding shall be of the permanent, waterproof type.

C. Upon completion of the loop, and prior to connecting the loop to the lead-in cable, each loop shall be megohm tested and tested for continuity in the presence of the Engineer. The insulation resistance of the loop conductors, lead-in cables, and splices shall not be less than 100 megohms.

D. Final loop connections shall be made such that each loop section is wound in the opposite rotation to an adjacent loop, whether such loop is in the same lane or in the adjacent lane.

E. The loops shall be joined in combination of series-parallel so that optimum sensitivity is obtained at the detector sensor unit, and shall be in accordance with the detector unit manufacturer's recommendation regarding series-parallel combinations.

F. Final splices between loops and lead-in cable shall not be made until the operation of the loops under actual traffic conditions is approved by the Engineer.

G. Loop detector lead in cable shall be Type B. Splices to lead-in cable shall be soldered, insulated and installed in a heat-shrink tubing, or approved equal.

H. Detector lead in cable shall be run continuous without splice form pull box to controller.

I. Each loop detector lead-in cable shall be identified and banded in each pull box and in the controller cabinet.

J. The sealant for filling slots shall be an Elastomeric Sealant, and shall conform to State Standard Specification 86-5.01A(5), 3M detector sealant, black 5000.

2.04 CONDUCTORS AND WIRING

A. Splices shall be insulated by "Method B" of the State Standards except detector lead in cables.

B. Conductors shall be cabled in bundles, by phase, and identified by phase with permanent labels in the controller cabinet and at terminal pull boxes.

C. Multiple lighting conductors, signal light grounded conductors, and bonding conductors only, may be spliced.

D. "C" shaped compression connectors shall be used.

E. Insulation shall be THW rated, and shall comply with Section 86 2.08B of the State Standards.

PART 3 - EXECUTION

3.01 MAINTAINING EXISTING ELECTRICAL SYSTEMS

A. Contractor must request in writing the Engineer's approval 72 hours prior to working within area of any signal system.

B. Electrician experienced in traffic control repairs and temporary traffic control signs shall be onsite at all times when work is being conducted within vicinity of signalized intersection and traffic loops.

C. Signals damaged by Contractor’s operation shall be repaired immediately.

D. The Contractor shall place "Stop Ahead" and "Stop" signs to direct vehicle and pedestrian traffic through the intersection during traffic signal system repairs. Temporary "Stop Ahead" and "Stop" signs shall be either covered or removed after the system is repaired.

E. One "STOP AHEAD" sign and one "STOP" sign shall be placed for each direction of traffic. For two-lane approaches, two "STOP" signs shall be placed.

F. "Stop Ahead" and "Stop" signs shall be furnished by the Contractor and shall conform to the provisions in Section 12-3.06, "Construction Area Signs," of the State Standard Specifications.

3.02 SIGNAL SYSTEM SHUTDOWN PENALTY

A. It is agreed by the parties to the contract that in case signal system shutdowns occur, damage will be sustained by the City and County, and that it will be impracticable to determine the actual damage which the City or County will sustain, it is therefore agreed that the Contractor shall pay to the City the sum of One Hundred Dollars ($100.00) per every hour or part thereof of signal system shutdown. The Contractor agrees to pay such liquidated damages as herein provided, and in case the same are not paid, agrees that the City may deduct the amount thereof from any money due the Contractor under the contract.

B. The Signal System Shutdown Penalty as provided for herein may be waived by the City if the Contractor installs a temporary traffic signal system for signal system shutdowns.

3.03 TESTING

A. The Contractor shall have present, a qualified field technician, who shall be qualified to perform testing and servicing on all systems of the installation.

B. The field technician shall perform all testing assignments. This testing shall include measurement of each loop installation repair utilizing a field loop tester/analyzer.

C. The Contractor shall provide the Engineer with the detector test report as provided.

3.04 FUNCTIONAL TESTING

A. The functional test for each lighting system shall consist of not less than 14 days. If unsatisfactory performance of the system develops, the conditions shall be corrected and the test shall be repeated until the 14 days of continuous, satisfactory operation is obtained.

END OF SECTION

SECTION 13202

MANGANESE TREATMENT SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies an automatic pressure type manganese treatment system (MTS), complete and operable.

B. The MTS includes a three cell horizontal pressure filter, filter media, filter piping, automatically actuating control valves and instrumentation that meet the performance and design data requirements as specified herein.

1.02 REFERENCES

A. Appendix B contains the raw water quality data for the water from the well for informational purposes only.

1.03 QUALITY ASSURANCE

A. The filter supplier shall be regularly engaged in providing horizontal pressure filters for manganese treatment for a minimum of 10 years.

B. The filter supplier shall provide a list of references based on five similar municipal potable water manganese treatment systems that have been completed within the last 10 years. Each references shall include a contact name, phone number, and address.

C. The filter supplier's trained field representative shall have overseen the installation and startup of not less than three pressure filter installations for MTS.

1.04 SUBMITTALS

A. Provide the following submittals in accordance with Section 01330.

1. Fabrication (Shop) drawings:

a. Plan and elevation views showing penetrations
b. Internal piping details
c. Anchor bolt size and locations
d. Filter media type and arrangement
e. Material list

2. Filter operation plan including:

a. Rinse to waste duration
b. Service cycle flow rate
c. Service cycle duration
d. Backwash duration
e. Backwash flow rate

f. Backwash initiation set points based on service cycle run time and pressure differential

g. Recommended chlorine dosage

h. Any other operational requirements needed to optimally operate the filter

3. Submit detailed step-by-step test procedures describing the methods, equipment, data collection, and method of chemical analysis to be used in performance testing specified in Part 3 of this Section.

4. Provide NSF 61 compliance certificates for concrete used within the filters for the filter media support along with necessary facilities for sampling and testing of the concrete for compliance.

5. Provide certification compliance with ANSI/NSF 61 requirements.

6. Provide seismic anchorage calculations in accordance with Section 01900.

7. Provide a list of references as detailed in Paragraph 1.03.

8. Furnish manufacturer's installation and operation manuals, bulletins, and spare parts list. Provide specific step-by-step instructions for operation of the filter system in all modes, and for extended-period shutdown and maintenance of any filter vessel or combination of vessels.

9. PLC program certification that it meets the intended operation of the MTS system per Paragraph 1.06.

10. Filter performance guarantee and two year warrantee

1.05 SEISMIC PROTECTION

A. The Contractor is responsible submitting design calculations showing that the manganese filter and all of its components will resist the total seismic forces in accordance with Section 01900.

1.06 UNIT RESPONSIBILITY

A. The MTS supplier shall be responsible for furnishing, and coordinating the assembly and installation, testing, and starting up of the manganese treatment systems. This responsibility shall include the pressure vessels and internals, internal concrete and gravel support, filter media, filter piping and valves (limited as shown on the drawings), and field instrumentation (limited as shown on the drawings), accessories, control panel, and miscellaneous controls as shown on the drawings.

B. The same supplier shall be responsible for supplying and coordinating the installation of the field instrumentation.

C. The filter supplier shall provide a control strategy to the PLC integrator for them to program the filter's operation.

D. The supplier shall provide five separate 8 hour meetings with the PLC integrator to develop, review, and factory test the operation of the MTS program.

E. The supplier shall submit to the Engineer a certification that the PLC program meets the intended operation of the MTS system prior to operational testing.

PART 2 - PRODUCTS

2.01 ACCEPTABLE SUPPLIERS

A. All equipment furnished under this Section shall be from a filter supplier who has been regularly engaged in the design and construction of manganese treatment system as stated in Paragraph 1.03.

B. The filter vessel shall be fabricated in an ASME certified manufacturing facility.

C. The filter vessel shall have the manufacturer's name, serial number, dimension, and pressure rating on a plate welded to the end bell of the vessel.

2.02 FILTRATION SYSTEM DESIGN REQUIREMENTS

A. The pressure filter system shall consist of two filters and shall be specifically designed to provide filtration and treatment for manganese removal based on the water quality sampling results. Media shall be either silica sand or greensand with anthracite along with a graded gravel support. The graded gravel support bed shall be layers of sand and gravel designed to disperse the backwash water uniformly across the entire filter cell area without channeling or excessive flows along the vessel walls. A chlorine feed system shall serve to continuously regenerate the silica sand or greensand to oxidize the soluble manganese.

1. Total treatment capacity is 3,000 gpm that will be split between two pressure filters operating in parallel.

2. Design requirements per individual filter are as follows:

a. The pressure filter equipment shall be designed based on the following requirements:

1) Design flow rate..... 1,500 GPM
2) Filter loading rate at design flow (max)..... 7.5 GPM/FT2
3) Maximum operating pressure..... 125 PSI
4) Minimum Service Cycle …….. 120 Hours
5) Maximum filter backwash rate..... 15 GPM/FT2
6) Maximum filter backwash flow rate..... 1,500 GPM
7) Maximum filter backwash waste volume… 45,000 gallons

B. The raw well water (raw water) will be aerated to remove entrained methane. The raw water will then be pumped out of the aeration sump from a variable speed booster pump that will pump through the manganese filter and into the concrete tank. Chlorination at the facility will be provided from gas chlorine that is injected into carrier water. The chlorine will be injected on the influent to the manganese filter with the chlorine concentration in the carrier water paced based on the flow from the booster pump.

C. Maximum flow velocity in piping connections to filters or within filters shall not exceed 6 fps. For the individual cell inlet the velocity shall not exceed 3 fps.

D. The system backwash water supply is to be a self-generated treated water source where two filter cells provide the supply to the backwashing cell. The source of the backwash water will be from the well.

E. During filter operation, maximum pressure drop from the inlet header connection to the filtered water connection to the distribution system shall not exceed three psi differential under clean filter bed conditions or ten psi differential prior to backwash.

F. Backwash rate shall be between 12 to 15 gpm/sf. A minimum of 140 percent of the recommended media bed expansion shall be possible during backwashing before the media reaches the invert of the inlet/backwash outlet header.

2.03 FILTER VESSEL

A. There are to be two filter vessels that will be piped in parallel. Future piping stub outs will be installed to allow for a future connection to a third future pressure filter that is not a part of this project.

B. Each vessel shall be of welded steel construction using SA-516 Grade 70 steel, and shall be tested to withstand a hydrostatic pressure 30% in excess of the designed working pressure of 150 psi. Each tank shall be designed shall be constructed per ASME code section VIII.

C. The filter system characteristics shall be as follows:

1. Filter type shall be a horizontal with three cell compartments for each vessel. The backwash water for a single cell shall be drawn from the other two cells.

2. Media shall be sand or greensand and anthracite over graded support gravel.

D. Each filter vessel shall be nominally 8-foot diameter by 30-foot long.

E. Each vessel is to include the following features:

1. One (1) 14-inch x 18-inch upper elliptical manhole per cell

2. One (1) 12-inch x 16-inch lower elliptical manhole per cell

3. One (1) 12-inch flanged nozzle for the inlet/backwash connection per cell

4. One (1) 12-inch flanged nozzle on the end bell for the common filter effluent

5. Two (2) lifting lugs

6. Two (2) saddle support legs

F. Filter Media

1. The filter supplier shall provide sufficient media for initial startup and operation of the filters.

2. Spare media shall be shipped in on cubic foot double bagged containers, sealed and on pallet with each bag marked as to its contents. Each spare media type shall be equal to 10 percent of the total type of media being provided.

3. All filter media and graded gravel support material shall be the product of a company experienced in the production of media for water filtration use.

4. Filter media materials, testing shipment, placement and preparation of filter for service shall conform to AWWA B100 or 102 latest revision.

2.04 FILTER PIPING, VALVES AND OTHER APPURTENANCES

A. Filter Inlet Distributor

1. Each filter cell shall be furnished with a full-length header inlet distributor/backwash collector system, constructed of stainless steel pipe.

B. Underdrain System

1. Each filter shall be furnished with a header lateral underdrain system designed to uniformly distribute backwash water and for collection of filtered water. The header and laterals shall be stainless steel. The laterals shall be slotted, wedge flow, pipe based design.

C. Surface Wash System (Not Used)

D. Filter Valves:

1. All filter valves shall be wafer type butterfly valves manufactured by Bray or approved equal

2. Manual Operating Valves shall have a hand wheel / gear operator

3. Motorized Valve Actuators (Actuators) shall be either of the following:

a. Open-close Actuators shall be Rotork IQT or approved equal. Actuator shall be provided with four configurable indication contacts configured to indicate the following: remote selected (AUTO), internal failure (FAIL), fully closed (CLOSE), and fully opened (OPEN). Four additional configurable contacts shall be provided. Actuator shall operate on 120VAC power and all contacts shall be rated 5A, 120VAC.

b. Modulating Actuators shall be Rotork IQTM or approved equal. Actuator shall set its position based on a 4-20mA set point signal and provide a 4-20mA valve position feedback signal (4mA = 0% open, 20mA = 100% open). Actuator shall be provided with four configurable indication contacts configured to indicate the following: remote selected (AUTO), internal failure (FAIL), fully closed (CLOSE), and fully opened (OPEN). Four additional configurable contacts shall be provided. Actuator shall operate on 120VAC power and all contacts shall be rated 5A, 120VAC.

E. Pressure gauges, differential pressure transmitters, and pressure transmitters shall be as specified in Division 17.

F. Combination Air Release / Vacuum Breaker (ARVB) Valves shall be manufactured by ARI or an approved equal.

G. Filter Influent Meter:

1. The magnetic flow meter shall be installed on the influent of each filter, and shall be a McCrometer Ultra Mag or approved equal.

2. Each flow meter shall be include a 12 inch diameter sensor tube, converter module, cable from the sensor to the converter, ground ring and gaskets all supplied by the manufacturer of the flow meter.

3. The sensor tube shall be shall be provided with a sufficient length of cable to reach the converter module.

4. Converter module shall be configured to display gallons minute and include graphics for flow rate variations, flow trend, status flags, etc.

5. Converter shall be capable of, and configured to, transmit a 4-20mA signal which is proportional to the full scale flow and a volumetric pulse. Converter shall operate on 120VAC power.

2.05 PERFORMANCE GUARANTEE AND WARRANTY

A. Performance Guarantee:

1. The Contactor shall review the filter influent raw water quality as stated shown in the Appendices and other requirements of these Specifications, and shall guarantee that the filter equipment supplied will consistently produce filtered water having manganese concentrations and operational characteristics as noted below:

Manganese concentrations in filter effluent	<0.01 ppm average 0.02 ppm maximum
Filter clogging rate	<0.5 ft/hr. at 4 gpm/sf.
Backwash consumption	<1 Percent of throughput volume

2. Submit a performance guarantee stating that the MTS will meet the performance requirements stated.

3. The Contractor shall provide all operating materials, chemical, power oversight, and make the filter supplier available during startup and testing for a period of not less than 15 days or until filter performance, as guaranteed, has been achieved for a continuous 10 day period, whichever is longer, at no additional costs to the City.

4. Contractor shall operate the MTS with a City certified Operator during the startup and testing.

B. Warranty:

1. The Contractor shall provide a written warranty for the satisfactory performance of the filter system for two years following system testing and acceptance by the City.

2. Provide warranty using the Special Guarantee form in Section 1781.

3. In the event that the filtration process does not meet the treated water manganese concentration limit or operation requirements as specified in this paragraph or if there is a difficulty or failure in controls or equipment, the Contractor will be notified by telephone and must provide advice on the corrective action within 24 hours.

4. If the performance or operation condition deficiency continues for more than three days, the Contractor shall make available the filter supplier's representative who shall come to the project site and provide the necessary equipment, materials and/or labor to correct the condition at no cost to the City and to their satisfaction.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Field Service:

1. The MTS supplier's field representative shall be onsite for a minimum of five 8-hour days during installation and four 8-hour days during startup to review the installation instructions with the Engineer and Contractor, witness the installation of the filter systems, train the Contractor's personnel in cautionary procedures critical to proper installation, and assist in startup. This will include the MTS supplier's field representative being present during placement of concrete fill in the vessels, installation of filter internal piping and internal components, testing of underdrain piping for clogging and slow distribution, placement of gravel support and filter media, initial washing of media, media conditioning and placing the completed filter system in service. The requirements of this Paragraph will not be waived or diluted.

B. Filter Placement:

1. The Contractor shall set the filter vessels in place; fill the bottom portion with concrete; grout the filter supports in place; and install the piping and fittings, valves, instrumentation, electrical, and appurtenances to provide a complete and operational system.

C. Underdrain Installation:

1. After the filter vessels are set in place and the underdrain laterals or collection nozzles have been installed, vacuum clean the underdrain area, all piping, and all surfaces that come into contact with the backwash supply water.

2. This cleaning must be favorably reviewed prior to placement of gravel support material. Test the underdrain for uniform water distribution by backwash, at a rate of 12 to 15 gpm/sf, depending on filter media type and as recommended by the filter manufacturer.

3. Correct any irregularities in the height of water jets emitted from the nozzle orifices prior to gravel placement.

D. Filter Coating:

1. The filter vessels shall be shipped to the site primed and finished coated on the interior per Section 09901 and factory primed on the exterior per Section 09901.

E. Field Paint Touch-Up of Filter Internals:

1. After placement of concrete, prior to placing gravel support material, inspect the interior of each vessel and touch-up any marred or scratched coating. Refer to Section 09901 for other requirements for field painting.

F. Media Placement:

1. Place filter media, wash, scrape, and add makeup media per AWWA B100 and B102. Sample and test media for conformance with the specification.

G. Filter Disinfection

1. Disinfect filter and piping per Section 02620 prior to placing in service.

3.02 FILTER STARTUP

A. Commissioning

1. Commission all systems and equipment to verify performance, function, and correct operation by performing procedures to activate, startup, adjust, test, and demonstrate that the work is in operating order in accordance with these general requirements of this Section and the detailed requirements of the technical sections under the system or equipment specified.

B. Notification:

1. Notify the City at least five days prior to starting each system or piece of equipment.

C. Coordination:

1. During the startup period, coordinate the operation of the equipment with City's operators.

D. Test Equipment and Chemicals

1. Furnish test equipment, measuring devices and supplies required to conduct tests. Maintain the equipment until acceptance.

E. Expendable Supplies

1. Furnish all expendable supplies required for startup, demonstration and testing and dispose of all waste or used supplies, and water. Provide all lubricants, and chemicals with the exception of chlorine (provided by City) as necessary until acceptance.

F. Startup References:

1. Refer to Specification Sections 01110 (Summary of Work), 01140 (Work Sequence and Constraints) and Section 01750 (Testing, Training and Facility Startup) for additional facility startup requirements.

3.03 PERFORMANCE TESTING

A. Filter Operation

1. The MTS supplier shall be present and work with the Contractor to startup the filters, make necessary adjustments, and demonstrate to the City that the complete filter system is in proper operating condition.

2. Demonstrate proper operation by operating the system continuously for a period of not less than four (4) consecutive calendar days. Accomplish at least two backwash events during this period under program control, one of which shall be induced by simulating a high headloss condition.

3. During the initial filter start-up, the water through the filter must be discharged to waste until favorable water quality results are achieved (meet requirements of Paragraphs 1.06 and 1.07).

4. Contractor shall be responsible for obtaining a temporary low threat discharge permit from Central Valley Regional Water Quality Board,

provide temporary piping and valves (as required), and de-chlorinate water prior discharging into the Sacramento County's storm drain system.

B. Water Quality Sampling

1. The MTS supplier shall be present a minimum of 7 days during the 15-day operational testing period. Over a period of fifteen (15) days, the Contractor shall collect samples and complete analyses of influent and effluent manganese levels twice per day as the silica sand media develops a manganese dioxide coating. The MTS supplier and Contractor will be allowed to alter, adjust, add, or replace system components as necessary to meet the performance requirements provided that these requirements are met prior to the contract completion date.

3.04 TRAINING

A. Operation Training:

1. During the performance testing period, the MTS supplier's trained representative and Contractor shall team to conduct an 8-hour training session for the City's operating personnel in the theory, function, operation, and maintenance of the filter system and PLC controls as well as the other PLC controls other than the manganese treatment system

B. 90 Day Inspection and Training:

1. As part of the treatment system training, provide the services of the MTS supplier's field engineer during the third month after system has been placed into service, to conduct a 4-hour inspection of the system operation in addition to a 4-hour onsite operation and maintenance refresher training session for the City's Operating Staff. Submit a report of the field trip to the City's information, pointing out any deficiencies and offering recommendations on maintenance activities, as appropriate.

3.05 FIELD SERVICE SUMMARY

A. The following is the minimum number of days of field service that will be provided by MTS supplier as summarized below:

1. Installation: …….. 4 days
2. Facility Startup: …….. 4 days
3. Performance Testing: ……. 4 days
4. 15-Day Operation: …….. 7 days
5. Training: ……. 2 days
6. 90 Day System Inspection: ….. ½ Day
7. 90 Day Refresher Training: ….. ½ Day

END OF SECTION

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SECTION 13212

BACKWASH RECYCLE TANK

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies the design of a 100,000 gallon backwash recycle tank (tank) and foundation along with inspection and cathodic protection. The tank dimensions are 35-foot diameter by 16-foot high shell height with a knuckle roof.

1.02 REFERENCES

A. American Iron and Steel Institute (AISI)

B. American Water Works Association (AWWA):

1. D100, Welded Steel Tanks for Water Storage
2. D102, Painting Steel Water Storage Tanks
3. C200, Steel Water Pipe
4. C207, Steel Pipe Flanges For Waterworks Service

C. American Society for Testing and Materials (ASTM)

1. A123, Zinc Coating on Iron and Steel
2. B633, Electro-deposited Coating of Zinc on Iron and Steel

1.03 SUBMITTALS

A. Submit in accordance with Section 01330.

B. Tank Submittals:

1. Tank dimensional drawings
2. Structural calculations of the tank
3. Welding data tabulation and details of welded joints
4. Erection drawings
5. Mill test reports of all steel materials with a certification of which ASTM or other AWWA D100 required specification each meets.
6. Written report as specified in AWWA D100-05 section 11.2.1.
7. Report certifying the inspection and compliance with AWWA D100-05 at the conclusion of the work.

C. Tank Foundation Submittals:

1. Structural foundation calculations
2. Concrete ringwall details
3. Foundation details

D. Accessories Submittals:

1. Accessory list with fabrication details
2. Catalog cuts, and descriptions of standard manufactured items
3. Plan and elevation details of shell, floor and roof penetrations
4. Plan and elevation details of the exterior stairs

E. Manufacturer's Certifications:

1. Tank design, including welded joint details and inspection personnel data
2. Tank fabrication, including mill tests and shop inspection report
3. Tank erection, including field inspection and testing report.

F. Cathodic Protection System

1. A complete list of the equipment and material, including the name and manufacturer, catalog number, size, finish and other pertinent data necessary for proper identification and conformance with the specifications.
2. Detailed design calculations

1.04 QUALITY ASSURANCE

A. General:

1. Demonstrate that the tank manufacturer has been regularly designing, fabricating and erecting similar steel tanks for at least 10 years.
2. Stamp and sign all shop drawings, calculations and welded joint details by a Civil or Structural Engineer registered in California.
3. Supply all new materials and fabricated items.
4. Verify adequacy of tank foundation.
5. The Contractor is responsible for preparing and submitting written Welding Procedure Specifications (WPSs). WPSs for each joint type shall indicate proper AWS qualification and be available where welding is performed. WPSs shall be included with any shop drawings referencing welds. WPSs shall include the manufacturer and specific electrode.
6. Submit written inspection report per AWWA D100, Section11.2.

B. Codes and Standards:

1. Tank Manufacture: AWWA D100.
2. Safety of Access: CCR and IBC.

C. Testing Program:

1. Qualification of Weld Procedures: AWWA D100.
2. Qualification of Welders: AWWA D100.
3. Shop and Field Weld Inspection: AWWA D100. If Section 14 applies, retain a Certified Welding Inspector.

4. Weld Inspection Procedures: AWWA D100.

5. Tank Bottom Weld Testing: AWWA D100.

6. Tank Water Tests: AWWA D100.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Requirements: Deliver, store and handle materials in strict accordance with the manufacturer's recommendations.

B. Material Storage: All materials and equipment stored at the site shall be protected from the elements where such exposure would be detrimental, and shall be adequately supported to prevent bending, warping, damage to painted surfaces, and other degradation of material properties. Painted components shall also be stored on supports to minimize contact with the ground.

1.06 WARRANTY AND FOLLOW-UP INSPECTIONS

A. The tank and its coating shall have a two (2) year warranty starting from the date of final acceptance. The Contractor shall be present for the one year and second year evaluation and shall furnish labor, equipment, lighting and assistance to inspect the tank and its interior and exterior coating.

B. Repairs requiring extensive work and equipment may be delayed until a time mutually agreeable to the City and Contractor. Repairs to the protective coating shall be completed in accordance with Section 09901 and tank manufacture's written instructions.

PART 2 - PART 2 - PRODUCTS

2.01 ACCEPTABLE SUPPLIERS

A. All equipment furnished under this Section shall be from a supplier who has been regularly engaged in the design and construction of potable water, welded steel tanks per Paragraph 1.04.

2.02 TANK

A. Design of the tank shall comply with AWWA D100 with a minimum corrosion allowance of 1/16-inch for all plates. The overall nominal tank dimensions are shown on the plans.

2.03 FOUNDATION

A. The reservoir foundation shall consist of a compacted fill with a sand cushion and reinforced concrete ring wall. The foundation and concrete ring wall shall be designed utilizing the recommendations contained in the City’s geotechnical report located in the Appendices of the Contract Documents. The Contractor shall provide foundation design calculations and details signed by a structural engineer licensed to practice in the State of California.

B. The foundation design shall be per AWWA D100-05 Section 12.6 for a flat bottom tank. The sand cushion shall be a 7% asphalt mix.

2.04 ACCESSORIES

A. The location of the accessories and tank penetrations are shown on the plans. The accessories include:

B. Shell Access Hatches:

1. Shell access hatches shall be flanged, gasketed and watertight.

C. Overflow Pipe:

1. The overflow pipe shall be designed for a flow rate of 5,000 gpm. Overflow capacity shall be provided with no greater than 3 inches above the weir crest height.

2. The overflow pipe will be inside of the reservoir and exit it 4 feet above grade. The pipe will discharge into a drainage vault with a 2 diameter air gap separation.

D. Internal Ladder:

1. The tank shall have one internal ladder.

2. The internal ladder shall be stainless steel and unpainted, shall be accessible from the interior tank floor, and shall extend to the roof access hatch.

3. The internal ladder shall be provided with a Saf-T-Climb device as manufactured by North Safety Products, or an approved equal.

E. Exterior Ladder for Roof Access

1. Exterior access to the roof shall be from an external ladder as shown on the drawings and have the following appurtenances:

2. Safety cage and lockable access from the bottom

3. Roof guard rail on each side the access ladder

4. Steel and painted with the same coating system as the tank

5. Include a Safe-T-Climb device as manufactured by North Safety Products, or an approved equal.

F. Roof Hatch:

1. The roof hatch shall be aluminum with steel hinges and locking hasps.

2. The manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The access hatch shall have a shoe box type lid.

G. Center Roof Vent:

1. The center roof vent shall be sized to provide venting to prevent a vacuum in the event of a sudden loss in water due to a break in one of the tank connections or a minimum of 5,000 gpm whichever is greater.

2. The center roof vent shall include the following:

a. Removable fiberglass cover

b. Stainless steel screens and hardware to secure screens

c. Stainless steel clasps to secure vent cover to vent

H. Float and Board Water Level Indicator

1. The float and board water level assembly shall be a Versa-Steel VS-A030, Varec 6700 series or an approved equal. The board shall extend from the tank's base to the top of its shell. The pointer shall travel in the same direction as the water level in the tank and have two guide wires. The board shall be aluminum with all other assembly equipment stainless steel. The board shall be secured to prevent damage from excess vibration associated with wind.

I. Floating Decant Skimmer on Tank Outlet:

1. A 6-inch minimum floating decant skimmer shall be provided and connected to the tank effluent to supply the backwash recycled line that feeds the methane treatment sump. The floating decant consists of a float skimmer connected to a flexible suction line. The contractor shall provide submittal drawings showing the float skimmer and flexible hose connections details to the tank.

J. Conduit Supports:

1. A 2-ft wide steel framing channel welded to the shell of the tank to support the conduits that serve equipment on the roof. The channel shall be painted with the same painting system as the tank. The first support shall be within 2 feet of the tank foundation with one intermediate channel and one channel at the top of the tank.

2.05 CATHODIC PROTECTION

A. The Contractor shall design and install a sacrificial anode cathodic protection system for the backwash recycle tank.

B. The anodes shall be suspended vertically from the roof of the tank. Hand holes and mounting devices shall be provided so the anodes may be replaced or inspected without entering the tank.

C. The cathodic protection system warranty shall be no less than two year after its activation and shall include all costs for parts and labor if a repair is required.

2.06 TANK FABRICATION

A. AWWA D100 and also:

1. Fabricate and assemble in the shop to the greatest extent possible.

2. Shape all members correctly, with no kinks, twists, dents or other blemishes prior to erection. Evenly spring all curved work.

3. Make exposed edges free of burrs and sharp edges. Make corners rounded or chamfered.

4. Shop prime all steel items that are not galvanized or epoxy-coated, with material that is compatible with the finish coat.

5. Stainless Steel Items:

a. Use the proper type of stainless steel electrodes or welding rods complying with AWS D10.4.

b. Remove by grinding and polishing, all scratches, marks, pits and other blemishes on exposed surfaces.

c. Use grinding wheels and other tools that have never been used on carbon steel.

2.07 SOURCE QUALITY CONTROL

A. Material: Verify that satisfactory mill test reports are available on all steel, including stainless steel.

B. Welding:

1. Verify welders are qualified.

2. Verify that weld procedures are followed.

C. Report: Provide a shop inspection report including mill tests, radiographs and inspection records, before tank erection is started.

PART 3 - PART 3 - EXECUTION

3.01 CONSTRUCTION

A. The construction shall conform to AWWA D100.

B. The internal and external coating of the tank and steel accessories shall be in accordance with Section 09901.

3.02 FIELD QUALITY CONTROL

A. AWWA D100, and also:

1. Provide four working days advance notice of all testing to the Engineer.

2. Provide all testing equipment and satisfactory access to the work being inspected.

3. Perform and evaluate all radiographs promptly, so any repairs can be made and re-evaluated without delay of the erection.

4. The Engineer will be the sole judge of compliance with the quality of work specified herein or in AWWA D100.

5. Repair all leaks and retest by the same method that discovered the leak at no additional cost to the City.

B. Tank Welding:

1. Independent Certified Welding Inspector:

a. The Contractor shall provide an independent Certified Welding Inspector to be present during all inspections and testing and to specify the test locations at no cost to the City.

2. Inspection by trepanning, air carbon arc gouging and removal of sectional segments will not be permitted.

C. Tank Bottom:

1. Test all joints by the vacuum method after erection and prior to painting.

D. Tank Bottom and Side Shell:

1. Test by the water method, after erection and prior to painting. The City will provide water. The Contractor shall be responsible for proper disposal of water used for testing the tank leakage integrity.

E. Report:

1. Provide a field inspection report, including radiographs and inspection records before acceptance of the tank by the City.

3.03 FLOATING DECANT

A. Install floating decant system as shown on the Drawings.

B. Decant shall operate freely at all tank levels, shall float level and plumb.

C. The Contractor shall provide additional weights as needed to adjust decant float level and at the correct level during operation.

3.04 PAINTING

A. Tank Painting and Coating

1. Perform interior and exterior cleaning, preparation, and painting in accordance with AWWA D102 and Section 09901 and as specified herein.

2. Paint top surfaces of all purlins, rafters, beams and all other roof structural members prior to the roof plate installation.

3. Paint lower side of roof plates prior to installation.

4. Seal weld all roof plate and structural member laps, prior to painting.

5. At columns, paint the top side of floor plates and the underside of column base plates prior to column erection.

6. Bottom side of floor plates shall not be painted.

B. Anniversary Inspection:

1. Provide 11th month and 23rd month first year and second year anniversary inspections, respectively, of the tank and coating, including testing and any required repair work, at no additional cost to the City. The City will dewater and pump out the solids per the designed operation plan.

2. The Contractor shall be responsible for washing down the inside of the tank and removing the solids from the bottom of the tank by disposing through the sidewall drain. The City shall capture the solids and dispose of them.

3. The City's Operating Staff shall be present during the inspection. Once the City has dewatered the tank and removed the solids readily removable by their normal pumping method, the Contractor shall complete the interior cleaning within 48 hours.

4. The interior inspection will be completed within the next 8 hours so that the tank can be put back on line.

5. The Contractor shall provide access to the interior roof for inspection using a lift or scaffolding and all work shall be completed within the time limits above. The lift or scaffolding equipment shall be provided with padding or rubber tired wheels to protect the floor coating. Any damage to the interior or exterior coating shall be repaired by the Contractor at no additional cost to the City.

6. The Contractor shall disinfect the tank per Section 02643 following inspection. The City shall de-chlorinate and dispose of the water and complete bacteriological testing prior to putting the backwash tank into service.

3.05 DISINFECTION AND DISPOSAL OF TEST WATER

A. Tank shall be disinfected in accordance with an approved method as described in AWWA D100 and per Section 02620. Tank shall be cleared of all materials and disinfected prior to acceptance. Tank shall pass a bacteriological test during leak testing and shall be clean of all material and sealed following flushing to remove disinfection chlorine. The City will conduct bacteriological testing. Any additional disinfection and testing resulting from failing to pass a bacteriological test shall be at the Contractor's expense.

B. Water used for testing procedures shall be discharged to the City's onsite storm drain system. Disposal shall be in accordance with all applicable federal, state and local regulations concerning the discharge (directly or indirectly) of pollutants to the underground and natural waters.

C. Chlorinated Water: Take special measures to prevent chlorinated water from entering storm drain system by providing de-chlorination.

D. The tank shall be inspected visually for leaks during the disinfection process.

3.06 CATHODIC PROTECTION

A. After the contractor has completed the installation of the corrosion control and monitoring station, the system shall be tested. Protection levels shall be per NACE Standard RP-01069.

B. All deficiencies shall be corrected by the contractor at their expense and retested prior to final acceptance. All retesting shall be at the contractor’s expense.

END OF SECTION

SECTION 13850

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Fire-alarm control unit.

B. Manual fire-alarm boxes.

C. System smoke detectors.

D. Heat detectors.

E. Notification appliances.

F. Remote annunciator.

G. Addressable interface device.

H. Digital alarm communicator transmitter.

1.02 SUBMITTALS

A. Action Submittals

1. Product Data: For each type of product, including furnished options and accessories.

2. Shop Drawings: For fire-alarm system.

a. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

b. Include plans, details, and attachments to other work.

c. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.

d. Detail assembly and support requirements.

e. Include voltage drop calculations for notification-appliance circuits.

f. Include battery-size calculations.

g. Include input/output matrix.

h. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.

i. Include performance parameters and installation details for each detector.

j. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

k. Include location of duct smoke detectors

1) Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.

2) Locate detectors according to manufacturer's written recommendations.

l. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

3. General Submittal Requirements:

a. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.

b. Shop Drawings shall be prepared by persons with the following qualifications:

1) Trained and certified by manufacturer in fire-alarm system design.

2) Licensed or certified by authorities having jurisdiction.

4. Delegated-Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data.

a. Drawings showing the location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the device.

b. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.

c. Indicate audible appliances required to produce square wave signal per NFPA 72.

B. Informational Submittals

1. Qualification Data: For Installer.

2. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

3. Sample warranty.

C. Closeout Submittals

1. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

a. Include the following and deliver copies to authorities having jurisdiction:

1) Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

2) Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the

"Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

3) Complete wiring diagrams showing connections between all devices and equipment.

4) Riser diagram.

5) Record copy of site-specific software.

6) Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

a) Equipment tested.

b) Frequency of testing of installed components.

c) Frequency of inspection of installed components.

d) Requirements and recommendations related to results of maintenance.

e) Manufacturer's user training manuals.

7) Manufacturer's required maintenance related to system warranty requirements.

8) Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

2. Software and Firmware Operational Documentation:

a. Software operating and upgrade manuals.

b. Program Software Backup: On magnetic media or compact disk, complete with data files.

c. Device address list.

d. Printout of software application and graphic screens.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

1.04 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. All components provided shall be listed for use with the selected system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Heat detectors.
2. Smoke detectors.
3. Duct smoke detectors.
4. Automatic sprinkler system water flow.
5. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Release fire and smoke doors held open by magnetic door holders.
5. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
6. Close smoke dampers in air ducts of designated air-conditioning duct systems.
7. Activate preaction system.
8. Recall elevators to primary or alternate recall floors.
9. Activate elevator power shunt trip.
10. Activate emergency lighting control.
11. Activate emergency shutoffs for gas and fuel supplies.
12. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. High- or low-air-pressure switch of a dry-pipe or preaction sprinkler system.
3. Elevator shunt-trip supervision.
4. Loss of communication with any panel on the network.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of communication with any addressable sensor, input module, relay, control module, or remote annunciator.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit and remote annunciators.
3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.

2.03 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

2.04 FIRE-ALARM CONTROL UNIT

A. Firelite or Equal

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.

2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.

2. Pathway Survivability: Level 0.

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.

2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.

3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

2.05 MANUAL FIRE-ALARM BOXES

A. Firelite or Equal

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38.

1. Single-action mechanism, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.

2. Station Reset: Key- or wrench-operated switch.

2.06 SYSTEM SMOKE DETECTORS

A. Firelite or Equal

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition.
    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    c. Multiple levels of detection sensitivity for each sensor.
    d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    a. Primary status.
    b. Device type.
    c. Present average value.
    d. Present sensitivity selected.
    e. Sensor range (normal, dirty, etc.).

2.07 HEAT DETECTORS

A. Firelite or Equal

B. General Requirements for Heat Detectors: Comply with UL 521.
1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature or a rate of rise.
1. Mounting: Adapter plate for outlet box mounting.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.08 NOTIFICATION APPLIANCES

A. System Sensor or Equal

B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464.

D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Mounting: Wall mounted unless otherwise indicated.

2. Flashing shall be in a temporal pattern, synchronized with other units.

3. Strobe Leads: Factory connected to screw terminals.

4. Mounting Faceplate: Factory finished, red.

2.09 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.

2. Store an internal identifying code for control panel use to identify the module type.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal.

1. Allow the control panel to switch the relay contacts on command.

2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

D. Control Module:

1. Operate notification devices.

2. Operate solenoids for use in sprinkler service.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture two telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.

2. Programming device.

3. LED display.

4. Manual test report function and manual transmission clear indication.

5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.

2. Address of the supervisory signal.

3. Address of the trouble-initiating device.

4. Loss of ac supply.

5. Loss of power.

6. Low battery.

7. Abnormal test signal.

8. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

B. Equipment Mounting: Install fire-alarm control unit on finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 16012 "Seismic Restraint for Electrical Equipment."

C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 16012 "Seismic Restraint for Electrical Equipment."

D. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.

2. Mount manual fire-alarm box on a background of a contrasting color.

3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.

E. Smoke- or Heat-Detector Spacing: Comply with NFPA 72.

F. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

G. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.02 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16075 – Electrical Identification.

B. Install framed instructions in a location visible from fire-alarm control unit.

3.04 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.05 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Perform the following tests and inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

a. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.

b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

D. Fire-alarm system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

F. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

G. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.06 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.07 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION

SECTION 13930

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Specialty valves.
4. Sprinklers.
5. Manual control stations.
6. Pressure gages.

B. Related Requirements:

1. "General-Duty Valves for Water-Based Fire-Suppression Piping" for ball, butterfly, check, gate, post-indicator, and trim and drain valves per NFPA 13, 2013

1.02 SUBMITTALS

A. Action Submittals

1. Product Data: For each type of product:
2. Shop Drawings: For wet-pipe sprinkler systems.
   a. Include plans, elevations, sections, and attachment details.
   b. Include diagrams for power, signal, and control wiring.

B. Informal Submittals

1. Coordination Drawings: Sprinkler systems, drawn to scale, on which items of other systems and equipment are shown and coordinated with each other, using input from installers of the items involved.
2. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.
3. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
4. Field quality-control reports.

C. Closeout Submittals

1. Operation and maintenance data.

1.03 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig maximum working pressure.

1. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers

b. Sprinkler Occupancy Hazard Classifications: Ord. Grp. 2.

2. Piping Design:

a. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1,500-sq. ft.

3. Maximum Protection Area per Sprinkler: According to UL listing.

4. Maximum Protection Area per Sprinkler:

a. Office Spaces: 120 sq. ft. Storage Areas: 130 sq. ft.

b. Mechanical Equipment Rooms: 130 sq. ft.

c. Electrical Equipment Rooms: 130 sq. ft.

d. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

C. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13.

2.02 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M,

B. Schedule 30, Black Steel Pipe: ASTM A 135/A 135M; and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Thinwall Black Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

D. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10

E. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

F. Cast-Iron Flanges: ASME 16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face**,** 1/8 inch ASME B16.21, nonmetallic and asbestos free.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.

b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

H. Grooved-Joint, Steel-Pipe Appurtenances:

1. Pressure Rating: 175-psig minimum.

2. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.03 SPECIALTY VALVES / CONTROL VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Specialty Valves Pressure Rating: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

2.04 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

B. Standard: UL 213.

1. Pressure Rating: 175-psig minimum

2. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.

3. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.

4. Branch Outlets: Grooved, plain-end pipe, or threaded.

C. Flow Detection and Test Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

2. Pressure Rating: 175-psig minimum.

3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.

4. Size: Same as connected piping.

5. Inlet: Threaded.

6. Drain Outlet: Threaded and capped.

7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

2. Pressure Rating: 175-psig minimum.

3. Body Material: Cast- or ductile-iron housing with sight glass.

4. Size: Same as connected piping.

5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Standard: UL 1474.

2. Pressure Rating: 250-psig minimum.

3. Body Material: Steel pipe with EPDM-rubber O-ring seals.

4. Size: Same as connected piping.

5. Length: Adjustable.

6. Inlet and Outlet: Threaded.

2.05 SPRINKLERS

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes: Chrome plated

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat or Chrome-plated steel, two piece, with 1-inch vertical adjustment

F. Sprinkler Guards:

1. Standard: UL 199.

2. Type: Wire cage with fastening device for attaching to sprinkler.

G. Standard: UL 393.

H. Dial Size: 3-1/2- to 4-1/2-inch diameter.

I. Pressure Gage Range: 0- to 250-psig minimum.

J. Label: Include "WATER" label on dial face.

PART 3 - EXECUTION

3.01 SERVICE-ENTRANCE PIPING

A. Connect sprinkler piping to water-service piping for service entrance to building. Comply with requirements for exterior piping per NFPA 13 and NFA 24. "Facility Fire-Suppression Water-Service Piping" for exterior piping.

B. Install shutoff valve, pressure gage, drain, and other accessories indicated at connection to water-service piping. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.02 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install alarm devices in Riser piping.

I. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

J. Install pressure gages on riser.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements of NFPA 13 for Fire-Suppression Piping."

L. Install sleeve seals for piping penetrations of concrete walls and slabs

M. Install escutcheons for piping penetrations of walls, ceilings, and floors per NFPA 13, 2013.

3.03 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

E. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

F. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.04 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

3.05 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

3.06 FIELD QUALITY CONTROL

A. Perform the following tests and inspections

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

4. Coordinate with fire-alarm tests. Operate as required.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.07 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

1. Standard-weight or Schedule 30, black-steel pipe with cut or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

2. Thinwall [Schedule 10] black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.08 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers

2. Rooms with Suspended Ceilings: Pendent sprinklers, Recessed sprinklers Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

B. Water-Flow Indicators:

1. Standard: UL 346.

2. Water-Flow Detector: Electrically supervised.

3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

4. Type: Paddle operated.

5. Pressure Rating: 250-300 psig.

6. Design Installation: Horizontal or vertical.

C. Valve Supervisory Switches:

1. Standard: UL 346.

2. Type: Electrically supervised.

3. Components: Single-pole, double-throw switch with normally closed contacts.

4. Design: Signals that controlled valve is in other than fully open position.

D. Electrically Operated Alarm Bell:

1. Standard: UL 464.
2. Type: Vibrating, metal alarm bell.
3. Size: 10-inch diameter.
4. Finish: Red-enamel factory finish, suitable for outdoor use.

END OF SECTION

SECTION 14660

OVERHEAD MONORAIL CRANE SYSTEM

PART 1 - GENERAL

1.01 SCOPE

A. Furnish all materials, equipment, labor, and incidentals necessary to furnish and place in operation the overhead monorail with motorized traveling cable hoist crane system, to be installed in the location as indicated on the Drawings. Work shall include the all auxiliary equipment and accessories as shown on the Drawings and as specified herein.

B. The crane system shall be furnished with monorail, electric motorized traveling tractor cable hoist, tractor hoist cabling, pendant controller, and all accessories and appurtenances specified, indicated on the Drawings, or otherwise required for a complete and properly operating installation.

C. All equipment shall be rated for an outdoor, exposed environment to allow for the hoist to be used on the outside portion of the monorail during inclement weather. The area classification shall be considered exterior wet. All devices or equipment shall be unclassified as defined by NEC. All equipment and enclosures shall be rated NEMA 4 or 4X.

1.02 COORDINATION

A. All equipment supplied under this Section shall be furnished by or through a single Crane System Supplier who shall coordinate with the Contractor, the design, fabrication, delivery, installation and testing of the crane system components. The Crane System Supplier shall have the sole responsibility for the coordination and performance of all components of the crane system with the performance and design criteria specified herein. The Contractor shall be fully responsible for a coordinated and functional design for the operating conditions specified. The Contractor shall be fully responsible for the satisfactory operation and testing of the crane system.

B. The Contractor shall be responsible to coordinate all details of the crane system components with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. The Contractor shall be responsible for all structural and other alterations in the Work required to accommodate the equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

1.03 REFERENCED SECTIONS

A. The following Sections are referenced in this Section

1. Section 01330 – Submittals
2. Section 09900 – Coating Systems
3. Division 16 Electrical

1.04 REFERENCE STANDARDS

A. American Bearing Manufacturers Association (ABMA)

B. American Gear Manufacturers Association (AGMA)

C. American Institute of Steel Construction (AISC)

D. American National Standards Institute (ANSI)

E. American Society of Mechanical Engineers (ASME)

F. American Society for Testing and Materials (ASTM)

G. American Welding Society (AWS)

H. Crane Manufacturers Association of America, a division of the Material Handling Industry of America (CMAA)

I. National Electrical Manufacturers Association (NEMA)

J. Occupational Safety and Health Administration (OSHA)

1.05 SUBMITTALS

A. The equipment manufacturer shall submit the following items:

1. Shop Drawings: General Arrangement drawings that illustrate the layout of the equipment, equipment weight, loads and capacities, clearances, protective coating systems, and principal dimensions with related verifications required for installation including anchorage locations. Other related data including specifications and descriptive literature, Electrical Control Drawings, Catalog Cut Sheets for individual components and Drive Motor Data.

2. Spare Parts & Tools: A list of recommended Spare Parts including any Special Tools required for routine maintenance of the equipment is provided as specified.

3. O & M Manuals including As-Built Drawings of the Crane System Arrangement, Controls and Accessories shall be provided in digital format after equipment ship for inclusion in the Close-Out Submittals process as specified in Section 01330 Submittals.

1.06 QUALITY ASSURANCE

A. The hoist and pendant controller shall be fully assembled and shop tested at the manufacturing facility prior to shipment.

B. All equipment furnished under this Section and related sections shall be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment and demonstrates, to the satisfaction of the Engineer, that the quality is equal to equipment made by those manufacturers specifically named herein. The hoist manufacturer shall have at least 10 installations of the specified models of equipment that have been in successful operation for at least 5 years.

1. The equipment furnished shall be fabricated, assembled, installed and placed in proper operation condition in full conformity with approved drawings, specifications, engineering data, and recommendations furnished by the equipment manufacturer.

2. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads.

1.07 WARRANTY

A. Equipment shall be warranted for a minimum period of one year, which shall commence upon written issuance of Certificate of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Crane system hoisting machinery, controls, and operator interfaces, and associated system components shall be of a common manufacturer and arrangement to the extent possible. Crane system shall be of one of the following, or equal:

1. CraneWerks, Inc.
2. Gorbel, Inc.
3. Harrington Hoists, Inc.
4. Or equal

2.02 DESIGN

A. The crane system shall be in accordance with applicable regulations and standards of the NEMA; OSHA part 1910 of the Title 29 of the Code of Federal Regulations; and national and local electrical codes.

B. Guards and covers shall be provided whenever necessary for the protection of operators or others from injury. Each guard and cover shall be easily removable for any and all required maintenance.

C. Refer to Design Criteria on Drawing GS01 Structural General Notes – 1 for additional criteria. Wind load specified applies to crane system when at idle. Crane system shall be designed for a while-in-use wind speed of 15 mph, minimum.

D. Design requirements:

Service	Outdoors, Exposed
Duty:	Intermittent
Minimum Monorail Load:	2 tons plus weight of hoist
Monorail Height:	Refer to Drawings
Monorail Length:	Refer to Drawings
Minimum Hoist Load:	2 tons
Ambient Air Temperature Range:	25 to 108 degrees Fahrenheit

2.03 COMPONENTS

A. Materials:

1. Unless otherwise noted, materials of construction shall be structural steel (ASTM - A36), shop coated per Section 09900 Coating Systems.

B. Equipment:

1. General: All fastening of equipment shall be adequate to hold equipment in its proper place and alignment during all phases of operation. All steel castings, steel forgings, and rolled or forged steel wheels shall be properly annealed. All torsional transmitting loads shall be made by suitable keys.

2. Bolts, Nuts, Washers, Cotterpins: Shall be type 316 SS, unless otherwise specified.

3. Keys and Keyways: The size of the keys shall be such as to be within safe bearing and shear limits for the materials in contact.

4. Setscrews: All setscrews shall have case-hardened cup points. When installed, heads shall be flush with surface. Setscrews shall not be used for transmitting torsion.

5. Monorail: Monorail shall consist of a structural beam member adequately sized for the load, and designed to be supported in the Control Building Chlorine Room as shown on the Drawings. Monorail shall be designed such that the load may deviate from plumb by a maximum of 15 degrees from vertical. Monorail manufacturer shall be TC American, or equal.

6. Hoist: Hoist shall consist of an electric motorized trolley and galvanized steel wire rope hoist. Minimum vertical lift travel shall be 14 linear feet below the minimum retracted hook height. The trolley shall move in a single speed and shall be provided with separate mechanical and electric motor brakes, capable of supporting the full load. The hoist shall lift or lower in a low speed or high speed operation. The hook shall be of the safety type with a latch.

7. All hoist components requiring protective coating shall be shop coated. Field coating of components is allowed for touch-up only.

8. Identification plates of stainless steel or aluminum, with clearly legible permanent lettering displaying the manufacturer's name, model number, maximum load capacity, and other pertinent information as required, shall be provided for each equipment component.

2.04 ELECTRICAL, CONTROLS, INSTRUMENTATION

A. The crane system shall be completely wired and ready for service after connection of power to the system.

B. All motors shall be totally enclosed fan cooled or non-ventilated, NEMA MG 1, with Class F insulation.

C. An outdoor weather rated pendant type controller shall be provided and shall be suspended from the hoist, and of adequate length to remain one foot above the ground surface when vertically suspended from the hoist. The pendant shall be suspended from the hoist with a strain relief chain which is slightly shorter in length than control wiring between the hoist and pendant controller. The pendant shall be a standard manufacturer provided controller.

D. Controls:

1. The pendant controller shall contain all necessary external control pushbuttons, including an emergency safety stop pushbutton, suitable for controlling all features of the traveling hoist.

2. Operable controls shall include hoist position and hoist hook extension/retraction. All operable controls shall be capable of being performed from the pendant controller.

3. Limit switches shall be provided for the upper and lower limits of the hoist travel, which shall de-energize the motor.

E. Refer to Division 16 for additional electrical requirements.

2.05 ACCESSORY LIFTING BAR

A. Provide lifting bar suitable for temporary attachment to the bottom of the hoist, with center hook point for hoist hook, and bar end hooks to allow for hooking to and lifting and lowering a full or empty industry standard 1-ton chlorine gas container.

B. Lifting bar shall be made of 5" channel, minimum 9.0 lbs. per foot, with heavy duty hooks cut from 1" steel plate, caution yellow dry powder polyester plastic coated to provide protection from corrosive environment.

C. Lifting bar shall of one of the following manufacturers, or equal:

1. Scaletron Industries Ltd., Model 3000LB™

2. Chlorine Specialties, Inc., Model C-262 Lifting Bar

2.06 SPARE PARTS

A. The supplier shall provide the following spare parts:

1. Quantity of Replacement Seals, Bearings, Bushings, and all other components which are subject to wear and must be replaced within two years of normal use, as recommended by the manufacturer.

2. One set of Special Service Tools as required for maintenance.

PART 3 - EXECUTION

3.01 GENERAL

A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions, as submitted with Shop Drawings, Operation and Maintenance Manuals and any pre-installation checklists. Installation shall utilize standard torque values and be installed secure in position and neat in appearance. Installation shall include any site preparation tasks as required by the Contractor or manufacturer; such as unloading, touch-up painting, etc. and any other installation tasks and materials such as wiring, conduit, controls stands as determined by the Engineer and/or specified by the manufacturer.

B. Anchor Bolts:

1. Anchor bolts and nuts shall be 316 stainless steel and furnished for each item of equipment by the Contractor. Anchor bolt template drawings shall be included in the submittal to permit verification of the location structural elements, new or existing in the concrete. Double-nutting shall be used where required to ensure the equipment is installed plumb and level. All gaps between equipment mounting surfaces and concrete surfaces shall be packed with approved non-shrink grout.

C. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation in accordance with the Startup Requirements section, and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.

D. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

3.02 FACTORY TESTING

A. Manufacturer shall test all equipment by performing all normal and emergency operations for the crane system with a suspended load. Load shall be properly lifted, moved, and lowered without overloading any component. The manufacturer shall make all necessary modifications and repeat testing until the tests can be passed. Manufacturer shall submit results of factory tests to the Engineer for review and acceptance prior to shipping the unit to the site.

3.03 INSTALLATION, FIELD TESTING, AND INSPECTION

A. Prior to startup, all equipment described herein shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test.

B. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is placed in operation in accordance with Testing and Startup Requirements shall revisit the jobsite as often as necessary until all trouble is corrected, and the equipment installation and operation are satisfactory in the opinion of the Engineer, at no additional cost to the Owner.

C. The equipment manufacturer shall furnish a qualified field installation supervisor during the equipment installation. Manufacturers' installation supervisor shall observe, instruct, guide, and direct the Installers erection or installation procedures. The equipment manufacturer will be provided with written notification 10 days prior to the need for such services.

D. The Contractor shall furnish test loads, operating personnel, instruments, and other items necessary to conduct field tests on the crane system. Initial tests shall be observed or witnessed by the Engineer. Owner shall be reimbursed by Contractor for all costs of subsequent visits by Engineer to witness or observe incomplete tests, retesting, or subsequent tests. The Contractor shall remain responsible for all manufacturer services costs, including subsequent visits required for retests.

E. After erection and inspection, the Contractor and the manufacturer’s representative shall test the trolley hoist as specified herein. Field testing shall include the following tests, at a minimum:

1. Perform all normal movement operations from the pendant controller for the crane system, including the full extension and retraction of the hoist, and the travel of the hoist on the monorail, under no load, and under each load test as specified herein.

2. Perform all emergency operations for the crane system, including stopping the crane system using each and every emergency stop.

3. Verify that all mating parts are in alignment and that there are no noticeable deflections or vibrations.

4. Functional and Performance Tests: Test the systems in service to determine that each component of the system operates as specified, is properly installed and adjusted, and is free from defects in material, workmanship, and installation. Correct all deficiencies and retest the system or component until testing proves the crane system is fully operational.

5. Test Data: Record test data on test record forms suitable for insertion into the Operation and Maintenance Manuals. Measure and record starting and operating current for electrical equipment using appropriate instrumentation (i.e., clamp-on style ammeters). Compare measured/recorded values with design specifications or manufacturer's recommended range values. Values which are different shall be justified, or appropriate adjustments performed. Abnormal high temperature, noise, or vibration, or abnormal operation of any equipment or component shall be recorded and corrected. Record trolley and hoist speeds during each test cycle.

6. No-Load Test: Raise and lower the hoist hook through the full range of normal travel at rated speed for three complete cycles. Raise and lower the hook, testing other speeds of the hoist as applicable. Verify proper operation of hoist limit switches. Operate the trolley in each direction the full distance between end stops. Operate through the entire speed range and verify proper brake operation.

7. Performance Load Tests, Hoist: Perform the following tests, as specified, with test loads of 50, 100, and 125 percent (plus 5 minus 0 percent) of rated hoist load. If the hoist is equipped with an overload limit device, disconnect it to allow the hoist to lift the test load. Proof test the overload limit device after it is reconnected.

8. Static Load Test (125 percent only): Check entire structure, holding brake and hoisting components as follows: Raise the test load approximately one foot. Hold the load for 10 minutes. Rotate the load and hook to check bearing operation. Observe lowering that may occur which indicates a weakness in the structure or malfunction of hoisting components or brakes.

9. Raise and lower and test load through the full lift range. Lower the load to the floor, wait 5 minutes, then raise fully up. Repeat lowering and raising cycles in the same manner two more times. As a minimum, operate in each speed for each test load where multiple speed options are available. In addition, the dynamic test of the second test load sequence (100 percent of rated load) shall be repeated for 10 cycles at rated speed, in order to demonstrate proper operation and repeatability of all functions without component overheating or malfunction. Completely stop the machinery at

least once in each direction during each cycle to ensure proper brake operation. The hoist shall not be stopped for more than 15 seconds prior to commencing the next cycle.

10. Hoist Load Brake (125 percent only): Raise test load approximately 5 feet above grade. With the hoist controller in the neutral position, release (by hand) the holding brake. The load brake should hold the test load. Again with the holding brake in the released position start the test load down (first point) and return the controller to the "off" position as the test load lowers. The load brake should prevent the test load from accelerating.

11. Hoist Loss of Power Test (125 percent only): Raise the test load to it's highest position. While slowly lowering the test load (first point), disconnect the crane's power source. Verify that the test load does not lower and that the brake is set.

12. Trolley: Operate the trolley the full distance of the monorail in each direction with a test load of 125 percent of rated load on the hook (one cycle). Check proper functioning of all drive speed control points. Verify proper brake action.

13. Rated Travel Performance Tests: Repeat travel tests for trolley with a test load of 100 percent of rated load. Repeat the test for five cycles at rated speed to demonstrate proper operation and repeatability of all functions without the overheating or malfunction of any components. Completely stop the machinery at least once in each direction during each cycle to ensure proper brake action. The machinery shall not be stopped for more than 15 seconds prior to commencing the next cycle.

14. Trolley Loss of Power Performance Test: With a test load of 100 percent of rated load, raise the test load approximately 3-feet above grade. Starting at a safe distance from any obstructions, attain a slow speed (first point) of trolley travel. While maintaining a safe distance from obstructions, disconnect the main power source at the control panel safety switch (disconnect) to simulate a power failure. Verify that the trolley stops and that the brake sets properly. Measure the distance required for the trolley to stop.

F. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress; and has been operated under full load conditions and that it operated satisfactorily.

3.04 TRAINING

A. The manufacturer's representative shall provide training of Owner personnel. Training shall consist of classroom and hands-on activities. Multiple training sessions should be provided to accommodate Owner personnel's schedules. Classroom training sessions may be recorded by the Owner for future use and training of new personnel.

B. Manufacturer shall provide a minimum of 1 trip for 4 hours of training.

END OF SECTION

SECTION 15050

PIPING SYSTEMS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work necessary to furnish, install, and test all piping systems, including exposed piping and buried piping, as shown on the Drawings and as specified herein.

1.02 REFERENCED SECTIONS

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals
2. Section 02215 – Tank Drainage Facilities and Waterproofing
3. Section 02643 – Water Pipeline Testing and Disinfection
4. Section 05501 – Anchor Bolts
5. Section 09900 – Coating System

1.03 SUBMITTALS

A. Submittals shall demonstrate full compliance with all aspects of this specification, and shall include, but not be limited to, complete manufacturers' data on all pipe material, fittings, and coatings. Submittals shall be provided in accordance with Section 01330 and shall include the following information:

B. Shop Fabricated Piping

1. Detailed pipe fabrication drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
2. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
3. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete-encased installations for Contractor-designed piping.
4. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
5. Thrust Blocks: Concrete quantity, bearing area on pipe, and fitting joint locations.
6. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.
7. Anchor Bolt Calculations: Calculations and shop drawings shall be submitted with the pipe support submittal in accordance with Section 05501 for all anchorage details. All calculations shall be prepared and signed by a civil or structural engineer currently registered in the State of California.

C. Contractor's below grade steel pipe submittal shall be completed and submitted to the Engineer within 30 working days from Notice to Proceed.

D. Equipment and Piping Coordination and Installation Drawings

1. The Drawings show only the general arrangements of the project equipment, piping and appurtenances. Contractor shall prepare and submit coordination and installation drawings that show the specific locations and dimensions of equipment, piping, valves, appurtenances, and related items, based upon dimensions for the actual concrete tank layout and equipment to be furnished from the accepted shop drawings.

2. Drawing Requirements

a. Drawings shall be prepared with AutoCAD software on a PC compatible hardware platform using Microsoft Windows operating system. The drawing files shall be submitted with each piping system print. The drawing files shall be submitted on rewritable CDROM disks.

b. The drawings shall be printed at a minimum scale of 3/8" = 1', on a minimum sheet size of 11" x 17". Piping shall be shown in plan and section views, or alternatively, as isometric piping spool drawings.

c. Piping of nominal size less than 8" may be single line with scaled lay lengths and fittings. Piping of size 8" and greater shall be double line with scaled flanges, lay lengths, and fittings. Each pipe run shall be dimensioned.

d. All pipe supports, thrust restraints, and seismic bracing shall be shown. All devices shown on the mechanical layout and schematic drawings and the P&ID drawings shall be shown.

3. During preparation of the drawings, Contractor shall provide interface and coordination between the tank shop drawings and all equipment suppliers and subcontractors, and, including as a minimum, the structural, architectural, mechanical, electrical, and instrumentation and control elements of the work.

4. Submittals shall include load and sizing calculations for pipe supports, thrust restraints, seismic bracing and related items which have been prepared, stamped, and signed by a professional civil, mechanical, or structural engineer licensed by the State of California.

5. Submittal and review of the coordination and installation drawings shall be completed at least 30 days prior to commencement of piping fabrication for each system.

1.04 REFERENCE STANDARDS

A. The standards listed below are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
ANSI B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800
ASTM A312	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D2564	Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
AWWA C104	Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water
AWWA C105	Polyethylene Encasement for Ductile Iron Piping
AWWA C111	Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron and Gray-Iron Pipe with Threaded Flanges
AWWA C151	Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids
AWWA C200	Steel Water Pipe 6-Inches and Larger
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe
AWWA C208	Dimensions for Fabricated Steel Water Pipe Fittings

1.05 DESIGN REQUIREMENTS

A. Design piping systems in accordance with the following:

B. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO Standard Specifications for Highway Bridges, as applicable.

C. Thrust Restraints:

D. Design for 150 psi test pressure.

E. Allowable Soil Pressure: 2,500 pounds per square foot.

F. Anchor bolts for pipe supports shall be designed in accordance with the CBC for Seismic Design Category D and Site Class D. This force shall be considered acting at the center of gravity of the piece under consideration.

PART 2 - MATERIALS

2.01 GENERAL

A. Pipe sizes are nominal inside diameter unless otherwise noted. All sizes of pipe shall be as called out on the Drawings and specified herein. All pipe and fittings delivered to the job site shall be clearly marked to identify the material, class, thickness, and manufacturer. All material shall be new and free of blemishes.

B. Where only one type of pipe is called out, no substitutions shall be allowed. Piping materials of like kind shall be the product of one manufacturer. All pipe shall be the regular product of a firm which has successfully manufactured comparable pipe for at least three (3) years. Pipe shall be accordance with Section 27 of the Standard Specifications. Appurtenances shall be accordance with Section 10 of the Standard Specifications

C. The Contractor is responsible for furnishing and installing all items necessary to make a complete and workable piping system. This includes, but is not limited to, valve boxes, insulating couplings and gaskets, piping specialties, and all other items required by the nature of the installation. Any item not specified herein but required by the installation shall be of first quality, equal in grade to similar materials specified herein, and shall comply with all applicable reference standards listed herein.

D. Paint exposed pipe in conformance with requirements of Section 09900.

2.02 PIPE IDENTIFICATION SCHEDULE

A. Piping materials are identified by a "Type" designation in these specifications. Specific piping materials,, testing requirements and other pertinent information is summarized for each pipe type. Pipelines are designated on the Drawings by a two-element code, the first representing the nominal pipe diameter and the second an abbreviation indicating the piping system. The following schedules, except where indicated otherwise on the Drawings, identify pipe type to be used for each piping system. Where the pipe type is not specifically identified on the Drawings, materials shall be selected based on the pipe service as listed in the following schedule unless otherwise noted all materials are as specified in subsequent articles of this specification.

Abbr.	Service	Pipe Type
CL	Chlorine Solution	Rigid: Pipe Type C – Schedule 80 Polyvinyl Chloride Pressure Pipe Flexible: Reinforced clear PVC flexible tubing with polyester braid
DD	Door Drain	Pipe Type C – Schedule 80 Polyvinyl Chloride Pressure Pipe
D	Drain	Below floor slabs: Type D-3 – Cast Iron Under Tank: Pipe Type B – Steel Pipe. Outside Tank and Building: 4 to 10 inch: Pipe Type D-2 –Polyvinyl Chloride Pipe 3 inch and smaller: Pipe Type C –Polyvinyl Chloride Pipe
IRR	Irrigation	Polyvinyl Chloride Pressure Pipe and Fittings per Irrigation Specifications
OF	Overflow	Pipe Type B – Steel Pipe
PD	Pump Discharge	Pipe Type B - Schedule 40 Polyvinyl Chloride Pressure Pipe
PFD	Perforated Drain	Schedule 80 Polyvinyl Chloride Pipe per Section 02215
PS	Pressure Sensing	Pipe Type H – Stainless Steel and Schedule 80 Polyvinyl Chloride Pressure Pipe
SD	Storm Drain	12 inch and larger: Pipe Type D-1 – Reinforced Concrete Pipe 4 to 10 inch: Pipe Type D-2 – Polyvinyl Chloride Pipe
SL	Sample Line	Pipe Type H – Stainless Steel Exposed and Schedule 80 Polyvinyl Chloride Pressure Pipe Buried
SS	Sewer	10 inch and smaller: Pipe Type D-2 –Polyvinyl Chloride Pipe
W	Potable Water	3 inch and smaller (inside building): Pipe Type G – Copper Pipe 3 inch and smaller (outside building): Pipe Type C – Schedule 80 Polyvinyl Chloride Pressure Pipe Larger than 3 inch: Pipe Type A–Ductile Iron Pipe between the Pump Station and the City Water Main as shown. All other pipe associated with the pump station and tank shall be Type B–Steel Pipe

2.03 PIPE TYPE A – CEMENT LINED DUCTILE IRON PIPE

A. Pipe

1. Ductile iron pipe shall be centrifugally cast from Grade 60-42-10 ductile iron and shall comply in all respects with AWWA C151 (ANSI A21.51).

2. Flanged pipe shall be Class 53 minimum. All other pipe shall be Pressure Class 350 minimum.

B. Fittings

1. Fittings shall be Class 350. Flange-joint fittings shall be Class 250. All fittings shall be ductile iron shall be manufactured in accordance with AWWA C110 (ANSI A21.10). Where taps are shown on fittings, tapping bosses shall be used.

C. Joints

1. Pipe Type A-1, Exposed Pipe

a. All joints on ductile iron pipe installed above ground shall be flanged or plain end joints as shown. Flanges shall be in accordance with AWWA C115 (ANSI A21.15) and AWWA C110 (ANSI A21.10), and faced and drilled to 125 lb ANSI B16.1 standards.

2. Pipe Type A-2, Buried Pipe

a. All joints on ductile iron pipe installed below ground shall be restrained push-on joints. Restrained joints shall be provided and shall be rated for a water working pressure of not less than 350 psi with a minimum of 2:1 safety factor. Restrained joints shall be provided by a welded-on retainer ring.

b. Welded-On Retainer Ring: Type Single gasket push-on type joint meeting applicable requirements of ANSI/AWWA C111/A21.11, with restraint provided by a welded-on retainer ring. Joints shall be U.S. Pipe TR Flex, American Lok-Ring, Griffin Snap-Lock, or equal.

D. Lining and Coating

1. All ductile iron pipe shall have a standard cement mortar lining seal coated with asphaltic material in accordance with AWWA C104 (ANSI A21.4). Exterior of buried pipe shall be coated with standard bituminous coating. Exterior of exposed pipe shall be painted in accordance with Section 09900 Coating Systems.

E. Polyethylene Encasement

1. The surfaces of all buried ductile iron pipe and fittings shall be encased with two sheets of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the piping and surrounding earth or backfill material. Polyethylene material shall conform to the requirements of ANSI/AWWA C105/A21.5. Material shall be 8 mil, linear low density polyethylene (LLDPE) and shall be marked at two foot intervals with manufacturer's name, year of manufacture, AWWA C105, film thickness and material, pipe size, and repair warning. All polyethylene shall be secured in place with 10-mil

polyvinyl tape. Installation shall conform to requirements of ANSI/AWWA C105/A21.5, Method A. Excess slack width in the polyethylene tube shall be taken up to make a snug, but not a tight fit, and secured with an adhesive tape wrapping around the pipe at the quarter points of each pipe length. Any rips, punctures or other damage to the polyethylene sleeve shall be repaired with adhesive tape or a short length of polyethylene tube cut open, wrapped around the pipe and secured in place.

F. Bolts, Nuts, Washers, and Gaskets

1. Bolts and nuts for flanges and fittings shall be high strength low alloy carbon steel hex bolts, as specified in AWWA C115 and C606.

2. Gaskets for flanged joints shall be 1/16 in. thick (1/8 in. thick for pipes 12 in. and larger), rubber conforming to applicable parts of ANSI B16.12 and AWWA C115 and C207. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in potable water lines. Gaskets shall be one piece with holes to pass bolts.

3. Gaskets for push-on joints shall be SBR, conforming to AWWA C111. Lubricant for push-on joint piping shall be the pipe manufacturer's standard.

2.04 PIPE TYPE B – STEEL PIPE

A. Pipe

1. Steel pipe shall be spiral or straight seam manufactured and furnished in accordance with AWWA C200. All materials, fabrication and shop testing of steel pipe and steel pipe fabrications shall conform to the requirements of ANSI/AWWA C200. All dimensions shall conform to ANSI/AWWA C208. The minimum thickness of plate for pipe from which fabrications are made shall be ¼-inch. Steel for AWWA C200 pipe shall conform to the requirements of ASTM A36; ASTM A572, Grade 42; ASTM A570, Grades 33 and 36; or ASTM A283, Grade D. For pipe size 3-inches and smaller refer to Section 15050-2.06.C.

2. Minimum wall thickness of butt-welded and flanged steel pipe shall be as presented in the table below:

8 inch and smaller	Schedule 40 unless otherwise noted
10 inch to 24 inch	0.25 inch unless otherwise noted
30 inch	0.30 inch unless otherwise noted

B. Fittings

1. All fittings shall be rated for 150 psi, as a minimum working pressure.

2. Steel pipe fittings shall conform to AWWA C208, elbows to have a 22.5 degree maximum miter section angle, minimum two sections, wyes, tees, crosses, and outlets to be reinforced in accordance with AWWA Manual M-11. Provide weld-o-lets for taps.

C. Joints

1. Joints for steel pipe shall be flexible couplings, flanged, bell and spigot welded joints, or welded butt straps as shown. Pipe with field welded joints shall be installed in accordance with AWWA C206. Welding operators, procedures, and details shall be qualified in accordance with AWWA C206.

2. Flanges where shown shall be slip-on or weld neck per AWWA C207, Class D, 125 lb. Nuts and bolts shall be electrozinc plated and of the sizes and quantities recommended in AWWA C207. Gaskets for flanged joints shall be sheet rubber gaskets in one piece conforming to AWWA C207 and ANSI B16.21, 1/8-inch thick. The gasket shall be full-cut, with holes to pass bolts. Gasket material shall be free from corrosive alkali or acid ingredients. Segmented straight-joint or interlocking gaskets will not be accepted. Blind flanges shall be gasketed with the entire face with the gasket cemented to the blind flange. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in potable water lines.

3. Flexible couplings (pipe sleeves) and flanged coupling adapters shall be furnished and installed by the Contractor. All couplings shall be suitable for a minimum working pressure of 150 psi. Flexible couplings for steel pipe shall be Smith-Blair Series 411, Romac Style 400, STRAUB Metal Grip, or equal. Flanged coupling adapters shall be Smith-Blair Series 913, Romac RC400, or equal. Sleeves shall be ten inches minimum length and have a fusion bonded coating suitable for potable water.

4. All welded pipe joints shall be field coated with cement mortar after installation as described herein.

D. Linings and Coatings

1. Exposed pipe in the pump station and tank shall be fusion bonded epoxy lined and coated in accordance with AWWA C213 and finished painted as specified in Section 09900. Fusion Bonded Epoxy shall be 100% solid, one or two coats minimum 7 MDFT.

2. Encased steel pipe under the pump station and tank shall be shop primed outside, and cleaned and lined with cement-mortar in conformity with ANSI/AWWA C205.

3. Buried steel pipe and fabrications shall be reinforced cement mortar coated in accordance with AWWA C205. Internal surfaces of the buried steel pipe and fabrications shall be cleaned and lined with cement-mortar in conformity with ANSI/AWWA C205.

4. Exposed steel pipe and fabrications within the below grade vault shall be shop primed outside. Internal surfaces of the steel pipe and fabrications shall be cleaned and lined with cement-mortar in conformity with ANSI/AWWA C205.

5. Prime coat all exposed metal surfaces (not mortar or fusion bonded epoxy coated) in the shop prior to delivery to the site with a minimum 5 mils of high build, anticorrosive epoxy metal primer measured as a dry film thickness. Surface preparation and application shall be as recommended by coating material manufacturer.

E. Dielectric Isolation

1. All piping shall be dielectrically isolated from piping or other materials constructed from dissimilar metals.

2. Flange dielectric insulation sets shall contain full faced gaskets, full length sleeves, and double insulating washers or as specifically indicated on the Drawings. Insulation material for the flange insulation sets shall be phenolic resin and flange faced gaskets shall be neoprene faced phenolic resin. All insulating materials shall be of a type designated by the manufacturer as suitable for use at the operating and test pressures specified for the type of pipe on which the materials are to be installed.

3. Insulating flange gasket sets shall be installed at the specified locations. All insulating components shall be cleaned of all dirt, grease, oil and other foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. After flanged bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved ohmmeter, and the minimum resistance shall be 50,000 ohms. All insulating flanged joints shall be coated.

F. Standard Joint Protection (Buried Pipe)

1. Exterior: After steel pipe section has been laid, clean the exposed metal at the exterior space at the joint. Wrap the joint with a strip of woven fabric (diaper) and band around the pipe at each side of the joint. The fabric shall be of such a weave as to allow the escape of air and excess water but prevent escape of mortar. Pour the joint full of grout (1 part cement to 1 part fine aggregate with sufficient water to form a consistency of thick cream) through a space in the woven fabric slightly to one side of the top. Rod the grout with a beaded wire or chain as it is poured into the joint. Immediately after completing the exterior joint, place damp earth over and around the joint to prevent rapid drying.

2. Interior: The inside joints of steel pipe 24 inches and larger shall be cleaned and thoroughly wetted before being filled with stiff cement mortar and finished off smooth by troweling or other equivalent method as approved. The inside joints of pipe less than 24 inches shall be mortared as specified in AWWA C205. Furnish sufficient swabs of the proper size and shape for use by the installation Contractor to remove excess mortar from the joints inside pipes with diameters less than 24 inches. These swabs shall be of rubber and capable of being inflated to the proper size for their intended use. The swabs shall be equipped with rings, straps, or similar devices which will permit a rope or cable to be attached to pull the swab through the pipe without deforming the swab to the point where the inside joint is not wiped clean.

G. Steel Wall Pipe

1. Fabricate of same material and thickness as connecting pipe, minimum thickness of 1/4-inch. Lining same as connecting pipe. Provide weep ring for all wall pipes to prevent water seepage with continuous fillet welded on each side all around. All penetrations through reinforced concrete

walls shall be constructed to prevent metal to metal contact between the pipe and reinforcing steel in the wall.

H. Pipe At Ground Level

1. Buried pipe material, coating, and lining shall extend to 6 inch above grade and shall terminate with a flange connection equipped with an insulating kit. Exposed piping shall be all pipes more than 6 inches above grade.

2.05 PIPE TYPE C – POLYVINYL CHLORIDE PRESSURE PIPE AND FITTINGS

A. Pipe PVC pipe shall be Schedule 40 or 80 as listed, Class 12454-B, rigid, unplasticized pipe made from polyvinyl chloride in accordance with ASTM D1784 and D1785. Joints shall be solvent weld, except that threaded or flanged joints are to be used where required at specific locations.

B. Fittings shall be Schedule 40 or 80 to match pipe, of the same material as the pipe, conforming to ASTM D2466.

C. Bolts, Nuts, Washers, and Gaskets

1. Bolts and nuts for flanges shall be Type 304 stainless steel, ASTM A193, Grade B8M hex head bolts and ASTM A194, Grade 8M, hex head nuts. Washers shall be of the same material as the bolts.

D. Solvent Cement

1. Solvent weld connections shall be made in strict accordance with the pipe manufacturer's recommendations using a solvent cement and primer (if recommended) meeting ASTM D2564. Solvent cement for Sodium Hypochlorite piping shall be IPS 724 CPVC solvent cement or equal. Primer shall be IPS P-70 primer or equal.

2.06 PIPE TYPE D – GRAVITY DRAINAGE

A. Pipe Type D-1

1. Pipe 12 inches and larger shall be reinforced concrete pipe and conform to the requirements of ASTM C76, Class III, unless otherwise shown. Joints shall be rubber gasketed and conform to ASTM C361.

B. Pipe Type D-2

1. Pipe 4 to 10 inches shall be polyvinyl chloride pipe and shall have a maximum dimension ratio of 26 unless otherwise specified and shall conform to ASTM D 3034. Pipe shall be furnished standard lengths of 20 feet. Joints shall be elastomeric gasket with bell and spigot ends. All material shall conform to the requirements of Sections 10.19 of the Standard Specifications.

C. Pipe Type D-3

1. Buried pipe below floor slabs three inch and larger shall be cast iron soil pipe, ASTM A74 with service hub and spigot compression type or hubless cast iron sanitary system per CISPI 301.

2.07 PIPE TYPE G – COPPER PIPE

1. For pipe 3 inches and smaller; exposed pipe shall be copper tubing type L, conforming to the requirements of ASTM B88. Joints shall be soldered or brazed with unions at valves and equipment. Solders shall be lead-free solder compatible with tubing and fittings materials. Fittings shall be wrought copper or bronze fittings meeting ANSI B16.22.

2. For pipe 3 inches and smaller; buried pipe shall be copper tubing type K, conforming to the requirements of ASTM B88. Joints shall be flared. Pipe shall be encased in 8-mil Polyethylene film prior to burial. Fittings shall conform to ANSI B16.22 or B16.26.

2.08 PIPE TYPE H – PRESSURE AND SAMPLE LINES

A. Pressure sensing lines and sample lines, above floor, ½ inch and smaller, shall be stainless steel tubing, ASTM A312 Type 316L, seamless, soft annealed, with flareless compression fittings. The minimum wall thickness shall be Schedule 40S. Stainless steel fittings shall be of the same material and pressure rating as the pipe.

B. Pressure sensing lines and sample lines buried, below floor, three inches and smaller, shall be PVC, ASTM D1785, Schedule 80. Provide magnetic tracer tape. Connections: plain end; solvent weld with threaded or flanged adapters for valves. Fittings, PVC, Schedule 80, socket weld.

2.09 PIPING CONNECTIONS – MISCELLANEOUS

A. Metallic Flexible Couplings and Flange Adapters

1. Where shown on the Drawings or required by installation, flexible couplings and flange adapters shall be furnished and installed by the Contractor. All couplings shall be restrained and suitable for a minimum working pressure of 150 psi.

2. Flexible couplings for steel pipe and steel pipe sizes shall be Rockwell (Smith-Blair) Type 411, Romac Style 400, Straub metal grip, or equal with the stop removed from the middle ring unless otherwise shown. Flexible couplings for cast or ductile iron pipe and equivalent sizes shall be Rockwell (Smith-Blair) Series 411, Dresser Style 38, Straub iron grip, or equal. Flexible reducing couplings shall be Rockwell Type 415, Romac Style RC400, or equal. Sleeves shall be galvanized steel or have a fusion bonded coating suitable for potable water. All coupling gaskets shall be synthetic rubber suitable for potable water.

B. Dielectric Isolation

1. General

a. All metallic piping shall be dielectrically isolated from all other metal piping, hangers, brackets, steel reinforcing and all other metal structures. All piping shall be dielectrically isolated from piping or other materials constructed from dissimilar metals.

2. Flange Insulators

a. Flange dielectric insulation sets shall contain full faced gaskets, full length sleeves, and double insulating washers or as

specifically indicated on the Drawings. Insulation material for the flange insulation sets shall be phenolic resin and flange faced gaskets shall be neoprene faced phenolic resin. All insulating materials shall be of a type designated by the manufacturer as suitable for use at the operating and test pressures specified for the type of pipe on which the materials are to be installed.

3. Wall Penetrations

   a. All penetrations through reinforced concrete walls shall be constructed to prevent metal to metal contact between the pipe and reinforcing steel in the wall.

4. Insulating Unions

   a. Insulating unions shall meet Federal Specifications WW-U-532, Class 1 requirements for dimensional, strength, and pressure requirements. Insulation barrier shall limit galvanic current to 1 percent of the short circuit current in a corresponding metallic joint. The insulating material shall be impervious to water. Each connector shall match the type of material to which it connects.

5. Pipe Supports

   a. Any pipe hangers, supports, brackets and saddles installed on the buried side of dielectric insulators on the protected pipe shall be dielectrically isolated from the pipe by insertion of dielectric insulating material between the hanger and the pipe.

6. Testing

   a. All dielectric isolation devices shall be field tested for continuity isolation prior to coating and backfill.

2.10 PIPING SUPPORTS AND HANGERS

A. General

1. All piping shall be supported against sag, lateral and vertical movement in a manner which will prevent undue strain on any valve, fitting, pipe or piece of equipment. Unless otherwise indicated on the Drawings, exposed piping shall be supported at the base of all risers, at intervals not to exceed 5 ft on all horizontal runs of pipe 2 in. and smaller, at intervals not to exceed 8 ft on all horizontal runs of pipe 2½ in. through 4 in., and at intervals not to exceed 12 ft on all horizontal runs of pipe larger than 4 in.

2. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at pipe connections to equipment and where otherwise shown.

3. Piping shall be supported as described hereinafter and as shown by the pipe support details on the Drawings. Manufacturer's catalog figure numbers are typical of the types and quality of standard pipe supports and hangers to be employed.

4. No attempt has been made to show all required pipe supports in all locations, either on the Drawings or in the details. The absence of pipe supports and details on any Drawings shall not relieve the Contractor of the responsibility of providing a satisfactory piping support system in

conformance with the functional and specific support spacing requirements of these specifications.

B. Hangers and Supports

1. Pedestal pipe supports shall be adjustable, with stanchion, saddle, and anchoring flange as shown, Grinnel, Fee, and Mason, or equal. Non-shrink grout shall be used under the floor flanges to give level bearing, and floor flanges shall be bolted to the floor with two stainless steel bolts cast in the concrete, if possible, or using stainless steel concrete anchors.

C. Anchors

1. All piping, raceways, accessories, and appurtenances shall be anchored to resist a lateral seismic force of 60 percent of its operating weight as required by the California Building Code. This force shall be considered acting at the center of gravity of the piece under consideration.

2. Piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system.

2.11 TAPS AND FITTINGS FOR INSTRUMENTATION

A. The Contractor shall provide all taps, fittings, shutoff valves, etc., for instrumentation, flow control valves and other devices installed in pipelines.

2.12 PRESSURE TAPS

A. Gauge taps shall be provided where shown. Gauge taps shall consist of a 1/2 in gage cock attached by threaded nipple to the pipeline, duct or equipment. Gage cocks shall be Robertshaw 1303, Ashcroft 1095, or equal. The exposed threads of each gage cock shall be protected by a brass plug.

PART 3 - EXECUTION

3.01 GENERAL

A. Piping shall be installed in accordance with these specifications and as specified in Section 26 of the Sacramento Standard Specifications for Public Construction.

3.02 PREPARATION AND HANDLING OF PIPE

A. Each pipe and fitting shall be carefully inspected before the exposed pipe or fitting is installed or the buried pipe or fitting is lowered into the trench. The interior and exterior protective coatings shall be inspected, and all damaged areas, which are repairable in the opinion of the Engineer, shall be patched in the field with material similar to the original. Pipe unable to be repaired shall be removed from the project site and replaced with new, undamaged pipe. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after laying.

B. Use proper implements, tools, and facilities for the safe and proper protection of the pipe. Carefully handle pipe in such a manner as to avoid any physical damage. Do not drop or dump pipe into trenches.

3.03 INSTALLATION OF PIPING

A. General

1. All pipes shall be carefully placed and supported at the proper lines and grades and, where possible, shall be sloped to permit complete drainage. Piping runs shown on the Drawings shall be followed as closely as possible, except for minor adjustments to avoid architectural and structural features. If major relocations are required, they shall be approved by the Engineer.

2. Wherever a pipe three inches in diameter and larger passes from concrete to earth, a flexible pipe coupling, shall be installed within 1 foot of the concrete. Particular care shall be taken to ensure a full support of the pipe in the earth between and beyond the joints.

3. When installing buried PVC pipe, it shall be “snaked” in the trench. In addition, PVC pipe shall not be laid when temperature is 32°F, or below. Piping shall be installed without springing or forcing the pipe in a manner which would set up stresses in the pipe, valves, or connected equipment.

B. Exposed Pipe

1. Exposed pipe shall mean any pipe not buried or encased in concrete. In erecting exposed pipe a sufficient number of screw unions, flanged or grooved end type joints shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs. Flanges and grooved couplings shall be employed on pipes 2½ inches and larger. The provision of an adequate number of appropriate take-down fittings must be rigidly adhered to whether or not such fittings are indicated on the Drawings. Take-down fittings shall also be provided within two feet of threaded valves and other appurtenances. Where piping passes through concrete or masonry walls, take-down fittings shall be employed within 3 feet of the wall.

2. All exposed pipelines shall accommodate expansion and contraction forces by the use of expansion joints, anchors, and pipe guides. Where pipes cross structure expansion joints, rubber spherical molded type pipe expansion joints with restraining rods shall be installed whether specifically shown or not.

3. All unrestrained joints in pressure pipelines, including bell and spigot, flexible couplings, expansion joints and flange adapters shall have tension bars (tie rods) provided in accordance with AWWA M11 Design Manual, Figures 19.15 and 19.16, and Tables 19.7 and 19.8. Thrust protection shall be for 1½ times the specified test pressure for the pipe.

C. Buried Pipe

1. General

a. All buried pipe shall be prepared as herein before specified and shall be laid on the prepared granular base and bedded to ensure uniform bearing. No pipe shall be laid in water or when, in the opinion of the Engineer, trench conditions are unsuitable. Joints shall be made as herein specified for the respective types. Take

all precautions necessary to prevent uplift and floating of the pipe prior to backfilling.

b. Piping under slabs and structures shall be encased in concrete unless otherwise directed by the Engineer.

2. Gravity Lines

a. Laying of gravity pipelines shall proceed upgrade with the spigot ends pointing in the direction of flow. Each piece shall be laid true to line and grade and in such manner as to form a close concentric joint with the adjoining pipe and to prevent sudden offsets in the flow line. As the work progresses, the pipe interior shall be cleared of all dirt and debris of every description. Where clearing after laying is difficult because of small pipe size, a suitable swab or squeegee shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. At times when work is not in progress, open ends of pipe and fittings shall be closed.

3. Corrosion Protection

a. All buried metal parts such as valves and bolt-ups not cement mortar coated shall be coated with two coats of bitumastic in accordance with Section 09900 Coating Systems, and encased with two sheet of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the protected metal and surrounding earth. All polyethylene shall be secured in place with 10-mil polyethylene tape.

4. Dielectric Connections

a. Where pipes of dissimilar metals are connected, a dielectric insulator shall be provided. Where copper pipe is supported from hangers, it shall be insulated from the hangers; or copper plated hangers shall be used.

b. Dielectric insulators shall be installed on the first exposed flanges or couplings of pipes which are connected to buried piping. For this purpose, an insulating joint or connection shall be provided on exposed existing and new piping which requires cathodic protection, within ten feet of each point of burial. Where connections are made between existing ferrous metal piping and new piping which is to receive cathodic protection, a dielectric insulator shall be installed.

c. Insulating flange gasket sets shall be installed at the specified locations. All insulating components shall be cleaned of all dirt, grease, oil and other foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. After flanged bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved ohmmeter, and the minimum resistance shall be

50,000 ohms. All insulating flanged joints shall be coated as shown.

d. Insulating unions shall be installed at the specified locations. Joint compound or thread tape shall be applied to male threads only. Piping shall be worked into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Threads shall be engaged so that no more than 3 threads remain exposed.

5. Locating Wire

a. All runs of water pipe, including services, shall have a No. 10 gauge solid soft drawn copper wire laid along the pipe to facilitate locating the pipe at a later date. The wire shall be stubbed up inside each valve box. Continuity test shall be conducted on each splice at all locations.

3.04 PIPELINE CLEANING AND TESTING

A. Water Pipelines

1. All water pipelines shall be subject to acceptance tests as specified in Section 02643. The Contractor shall provide all necessary utilities, labor, and facilities for testing, and shall dispose of all waste, including water. All tests shall be conducted in the presence of the Engineer.

B. Cleaning

1. The interior of all pipelines shall be thoroughly cleaned of all debris prior to testing and prior to connection of pipe to equipment, control and regulating devices or instrumentation. Cleaning shall be accomplished by flushing with water at a velocity of 2.5 ft/s or by pulling a tightly fitting cleaning ball or swab through the pipe. Accumulated debris shall be removed by dropping spools or valves. No test shall commence until the pipeline is completely cleaned to the satisfaction of the Engineer. Pump suction lines shall be cleaned prior to operation of pumps.

C. Disinfection

1. Disinfect all water piping as specified in Section 02643. Disinfect all new water pipe sections prior to making final connection to existing active operating piping.

D. Gravity Pipelines

1. Unless otherwise directed, Contractor shall perform Closed Circuit TV camera (CCTV) inspections of all new installations of sewer, and/or storm drain pipes. Comply with Section 26-12 requirements. In addition, all sewer and storm drain pipelines shall be subject to air or hydrostatic testing as specified in Section 26 of the Sacramento Standard Specifications.

END OF SECTION

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SECTION 15100

VALVES AND APPURTENANCES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Miscellaneous valves and accessories for water service. Valves shall be installed in accordance with the manufacturer's recommendations. Valves shall be suitable for pressures up to 150 psi. Valves shall be complete with all necessary operating hand wheels, extension stems, valve boxes, floor stands, worm and gear operators, operating nuts, hardware and fasteners, and wrenches which are required for the proper completion of the work included under this section.

1.02 SECTION INCLUDES

A. The following Sections are referenced in this Section:

1. Section 01330 – Submittals
2. Section 09900 – Coating System

1.03 SUBMITTALS

A. Submittals shall demonstrate full compliance with all aspects of this specification, and be submitted in accordance with Section 01330.

1.04 REFERENCE STANDARDS

A. The standards listed below are part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
AWWA C504	Rubber-Seated Butterfly Valves
AWWA C509	Resilient Seat Gate Valves for Water and Sewage Systems
AWWA C550	Protective Interior Coatings for Valves and Hydrants

PART 2 - PRODUCTS

2.01 GENERAL

A. Valves shall be furnished full line size unless specifically called out to be of reduced size. Unless otherwise specified, valves shall be rated for 150 psi working pressure minimum.

B. All valves shall be complete with all necessary operating hand wheels, chain wheels, extension stems, valve boxes, floor stands, worm and gear operators, operating nuts, chains, hardware and fasteners, and wrenches which are required for the proper completion of the work included under this section. Operating torque to operate any valve shall not exceed 40 ft-lb. Unless otherwise indicated, the direction of rotation of the wheel, wrench nut or lever to open the valve shall be counterclockwise. Each valve body or operator shall have cast

thereon the word "OPEN" and an arrow indicating the direction to open. Actual length of valves shall be within 1/16 inch (plus or minus) of the specified or catalog length except where installed adjacent to flexible or mechanical pipe couplings, where different lengths of a replacement can be accommodated. Flanges shall meet the requirements of ANSI B16.

C. Valve boxes and extended stems to within 24 inches of finished grade shall be provided for all buried valves.

2.02 MANUAL ACTUATORS

A. All valves, except those which are equipped with power actuators or are designed for automatic operations, shall be provided with manual actuators. Unless otherwise specified or indicated on the Plans, each manual actuator shall be equipped with an operating hand wheel. Manual operators for butterfly valves shall be designed in accordance with AWWA C504 and shall have a disc position indicator designating the opened and closed position of the valve.

B. Operators for butterfly valves six-inches in diameter and smaller shall be level actuators and permit locking the valves in at least five intermediate positions between fully open and fully closed. Operators for butterfly valves eight-inches in diameter and larger shall be the traveling nut type. Manual operators for exposed service valves shall include a handwheel and be of the traveling nut, rack and pinion, or worm gear type and be gasketed for weatherproof service. Operators shall be equipped with adjustable mechanical stop-limiting devices to prevent over-travel of the disc in the open and closed positions and shall be self-locking and designed to hold the valve in any intermediate position between full open and full closed. Valve operator components shall withstand an input torque of 300 ft-lbs at the extreme operator positions without damage.

C. Operators for buried service shall be provided with a two-inch square operating nut unless otherwise specified or shown. Operating extension stems shall be provided to bring the operating nut to a point six inches below the surface of the ground and box cover. Extension stems shall be constructed of steel and shall be complete with two-inch square operating nut.

2.03 BUTTERFLY VALVES

A. Butterfly valves shall be manufactured in accordance with the latest revision of AWWA C504, class 150B. Valves shall be iron body, flange ends, rubber seated, tight-closure. The manufacturer shall have produced AWWA butterfly valves for a minimum of five years. Valve interior shall be epoxy coated in accordance with AWWA C550 suitable for drinking water. Thru bolts connecting valves to main shall be carbon steel ASTM A193 grade B7 with ASTM A 194 grade 2H heavy hex nuts, or bolts and nuts of equivalent physical properties. Bolts that thread into the valve body larger than 1 inch shall have the same thread pitch as the valve body and conform to ASTM A193 grade B7 having UNC threads.

B. The actuator shall be equipped with a standard water works two inch (2”) square wrench nut. The actuator shall open the valve left (counterclockwise), and shall be furnished with a position indicator if installed in a vault. Provide valve operating nut extensions in accordance with Standard Drawing W-308 in Section 38 of these Standard Specifications when installed valve operating nut is in excess of thirty inches (30”) below finish grade.

C. Valve seats shall be field adjustable around the full three hundred and sixty degrees (360°) circumference and replaceable without dismantling operator, disc or shaft and without removing the valve from the line. Seats attached to the valve disc are not allowed. All shafts shall be turned, ground and polished and constructed of 18-8 Type 304 stainless steel conforming to ASTM A 276. Valve shaft seals shall consist of self-adjusting "V" type packing capable of replacement without removal of the valve shaft.

D. All valves shall be fitted with non-metallic sleeve-type bearings. Bearings shall be corrosion resistant and self-lubricating. Bearing load shall not exceed one-fifth of the compressible strength of the bearing or shaft material. Non-adjustable thrust bearings designed to center the valve disc shall be furnished with the valve assembly and be preset at the factory.

E. Butterfly valves shall be manufactured by Dresser, Mueller, Kennedy, Pratt, or equal.

2.04 GATE VALVES

A. All small gate valves of a size less than three inches for threaded joints shall be Crane Company No. 438, Mueller H10914, or equal, with wedge disc and rising stem and screwed ends.

B. Resilient – Seated gate valves shall be cast iron, non-rising stem with a two inch (2") square operating nut. Valves shall conform to AWWA C 509. All interior and exterior ferrous surfaces shall be and coated with factory applied epoxy in accordance with AWWA C 550. Minimum thickness shall be eight (8) mils. Bolts shall be carbon steel ASTM A 193 grade B7 with ASTM A 194 grade 2H heavy hex nuts, or bolts and nuts of equivalent physical properties.

C. Valves provided shall open left (counter clockwise), and shall have bonnet and valve body markings in accordance with the indicated AWWA standards. Unless otherwise directed, furnish valves with flange, mechanical, and/or push-on joints in accordance with the plans and special provisions. Provide valve operating nut extensions in accordance with Standard Drawing W-308 in Section 38 of the Standard Specifications when installed valve operating nut is in excess of thirty inches (30”) below finish grade.

D. All larger valves shall be iron body with bronze stem nuts, glands, and bushings; resilient-seated gate valve with resilient seat bonded or mechanically attached to the gate; non-rising stem (NRS); working water pressure of 200 psi; and conforming to the requirements of AWWA C509. Gate valves installed in vertical pipelines shall be of square bottom construction.

2.05 PLUG VALVES

A. Cast iron or ductile iron body and plug, neoprene plug facing, stainless steel valve seat, Buna-N or PTFE stem packing, and Type 316 stainless steel plug bearing. Non-lubricated eccentric plug valve, suitable for drip-tight, bi-directional shutoff at 150 psi design pressure. Port area of at least 80 percent of the full pipe cross-sectional area. Bolts, Studs, Nuts and Washers: Zinc plated in exposed installations, Type 316 stainless steel in buried installations. Valve as manufactured by DeZurik, Clow Valve Company, or equal.

2.06 BALL VALVES

A. Unless otherwise indicated or specified, all 2½-inch and smaller shutoff valves shall be ball valves.

B. Two-inch and smaller ball valves for general air and water service shall be of bronze or brass construction with two piece end entry body, with threaded ends, Teflon seats, and hand lever operators. Valves shall be rated not less than 500 psi non-shock cold WOG and shall be drip tight in both directions. Valves shall be Apollo 70-100 series, Stockham S-216, or equal.

2.07 HOSE VALVES

A. Hose valves shall be one and one/half -inch in size unless otherwise indicated on the Plans. Valves shall be Class 125 angle valves with bronze body seat and disc equipped with hose nipple. Hose nipple shall be all brass with double male ends, NPT by straight hose tread. Valves shall be Stockham B-216, Walworth Fig 3059, or equal. Provide valve with vacuum breaker/backflow preventer in chlorine room.

2.08 SILENT CHECK VALVES

A. Silent check valves shall be ductile iron body, bronze trim, center guided, stainless steel spring, and resilient seating. The minimum flow cross-sectional area shall be greater than the flow area of the pipe. The design shall provide a globe-style body, a center-guided, spring-loaded disc, guided at both ends with bronze bushings and bronze shafts. The valve shall be designed for a water working pressure of at least 125 psi. Silent check valves shall be Valmatic Series 1800, or APCO Series 600.

2.09 ELASTOMER TYPE CHECK VALVES

A. Elastomer type check valves shall be slip-on or Class 125 flanged, as shown, round entry area to match pipe, contoured duckbill exit, rated for 50 psi minimum operating pressure, designed to open with 2 inches of line pressure and return to closed position under zero flow, as manufactured by Tideflex, Onyx or equal.

2.10 SERVICE SADDLES

A. Double-strap design rated 150 psi minimum working pressure.

B. Run diameter compatible with outside diameter of the pipe on which the saddle is installed. Taps with iron pipe threads.

C. Malleable or ductile iron bodies and galvanized steel straps, steel hex nuts w/washers, and neoprene seals.

D. Manufacturers and Models: Smith-Blair, Inc., Series 313; Romac Industries, Inc., Series 202; or equal.

2.11 VALVE APPURTENANCES

A. Extension Stems for Buried Valve Operators

1. Where the depth of the valve is such that its centerline is more than three feet below grade, operating extension stems shall be provided to bring the operating nut to a point six inches below the surface of the ground

and/or box cover. Extension stems shall be constructed of steel and shall be complete with two inch square operating nut.

B. Valve Boxes

1. Valve boxes shall be provided for all buried valves. They shall be concrete construction with a minimum throat diameter of nine inches and minimum wall thickness of one inch. Valve boxes shall have cast-iron bases and covers with the appropriate service designation cast thereon. All parts shall be bituminous varnish coated. Valve boxes shall be Christy Concrete Products No. G-5 or equal. PVC pipe risers shall be C900 PVC, 8-inch diameter, extend to valve box and shall fit inside the valve box without slipping. Tracer wire shall be placed outside the riser pipe.

2.12 AIR RELEASE VALVES (ARV)

A. Air release valves located at each pump shall be of the simple lever type, 1/2-inch inlet and outlet unless otherwise shown, designed to have a small 3/32-inch venting orifice to vent the accumulation of air and other gases that may occur within a pipeline while the pump is operating. In closed position, valve to seat against resilient seat to prevent water leakage. Body and cover, cast or ductile iron; float and trim, stainless steel; seat, Viton or Buna-N. Provide return vent pipe turned 180 degrees downward and discharging to floor drain. Isolation valves shall be provided below each air valve.

B. Manufacturers and Products: APCO, Model 50; Val-Matic Valve, Model 22; or equal.

2.13 COMBINATION AIR VALVES (CAV)

A. Combination air valves for water service shall be single-body construction. Combination air valves shall have a small venting orifice to vent the accumulation of air and other gases with the line or system under pressure and shall have a large venting orifice to permit the release of air as the line is filling or relieve the vacuum as the line is draining or is under negative pressure. Valve shall have a two-inch inlet and outlet unless otherwise shown and designed to have a small 3/32-inch venting orifice. Body and cover, cast iron and ductile iron; float and trim, stainless steel; seat, Viton or Buna-N.

B. Provide return vent pipe turned 180 degrees downward. Isolation valves shall be provided below each air valve.

C. Manufacturers and Products: APCO Series 140/150; Val-Matic Valve, Model 202C; or equal.

2.14 FIRE HYDRANTS

A. Fire hydrants shall be dry barrel type in accordance with AWWA C502, and Sacramento Standard Specifications, Section 10.31. A six-inch gate valve shall be installed between the hydrant and the main line. The flange of the hydrant bury shall be two inches above finished grade. Break off riser shall be installed on all hydrants.

B. Interior surfaces shall be factory applied epoxy coated. Hydrants shall be painted in the shop. Color shall be based on diameter of water main connected to hydrant.

PART 3 - EXECUTION

3.01 PLACING

A. Valves installed in vertical runs of pipe shall have their operating stems oriented to facilitate the most practicable operation, as approved by the Engineer.

3.02 ANCHOR BOLTS

A. Anchor bolts, nuts, and washers shall be Type 316 stainless steel and shall be cast in place during concrete placement. Threads shall be protected and shall be cleaned before the nuts are attached and tightened.

3.03 TESTING

A. Valves shall be tested at the same time that the adjacent pipeline is tested. Joints shall show no visible leakage under test. Joints that show signs of leakage shall be repaired prior to final acceptance. If there are any special parts of control systems or operators that might be damaged by the pipeline test, they shall be properly protected. The Contractor shall be held responsible for any damage caused by the testing.

B. If requested by the City, the valve manufacturer shall furnish an affidavit stating the materials options furnished, and/or that these and other referenced specifications have been complied with.

3.04 CORROSION CONTROL

A. Exposed valves shall be painted in accordance with Section 09900. All buried metal parts such as valves and bolt-ups not cement mortar coated shall be coated with two coats of bitumastic in accordance with Section 09900 and encased with one sheet of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the protected metal and surrounding earth. All polyethylene shall be secured in place with 10-mil polyethylene tape.

END OF SECTION

SECTION 15220

RESERVOIR ALTITUDE VALVE

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Pressure sustaining control valve for reservoir filling. Valve shall be a hydraulically operated globe valve with diaphragm. Provide all accessories for a complete operating system.

1.02 REFERENCED SECTIONS

A. The following Section is referenced in this Section:

1. Section 01330 – Submittals

1.03 REFERENCES STANDARDS

A. American National Standards Institute (ANSI) standards, most recent editions:

1. ANSI B16.42 -- Ductile Iron Pipe Flanges and Flanged Fittings.
2. ANSI/AWWA C116/A21.16 -- American National Standard for Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
3. NSF/ANSI 61 -- Drinking Water System Components-Health Effects.

B. American Society for Testing and Materials (ASTM) standards, most recent editions:

1. ASTM A536 -- Standard Specification for Ductile Iron Castings.
2. ASTM A240 -- Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.

C. National Electrical Manufacturers Association (NEMA).

1.04 SUBMITTALS

A. Submittals shall demonstrate full compliance with all aspects of this specification, and be submitted in accordance with Section 01330.

B. Furnish Submittals Prior to Installation as specified.

1. Submit detailed technical information relating to each type of valve including descriptions of component parts, materials of construction, performance, and dimensions.

C. Process and Instrumentation Diagram

1. Provide full P&ID with associated tag numbers.

D. Installation, Operation, and Maintenance Instructions:

1. Furnish installation, operation, and maintenance instructions for each type of valve. Include information on valve operators in operation and maintenance instruction manual.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of the valve(s) shall have had 10 years successful operational experience in comparable service.

B. Each valve shall be tested prior to shipment. The standard test shall include a pressure test and a fully functional operations test for the valve's intended particular application.

C. The valve(s) shall be covered by a minimum three year (3) warranty against defects in materials and workmanship.

D. All repairs and maintenance shall be possible without removing the valve from the line, when installed in accordance with manufacturers' recommendation.

1.06 DELIVERY STORAGE AND HANDLING

A. Protect valves from damage during handling and installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Control Valves: Manufactured by Singer Valve to match existing equipment.

B. Main Valve Components

1. Body and Cover:

a. All pressure containing iron components shall be constructed of ASTM A536-65/45/12 Ductile Iron.

b. The flanges shall be designed to ANSI Class 150 standards.

c. All ductile iron parts on the valve shall be protected internally and externally by a coating of NSF-61 approved fusion bonded epoxy. The protective fusion bonded epoxy coating shall conform to the ANSI/AWWA C116/A21.16 specification.

d. On valve(s) 3" and larger, cover bonnets shall be accurately located to bodies utilizing locating pins.

e. The valve cover shall have a separate stem cap giving access to the stem for alignment check, spring installation and ease of assembly.

2. Seat Ring: Shall be constructed of type 316 Stainless Steel.

a. The seat ring on valve(s) 3" and larger shall be bolted in place by utilizing "Spiralock" thread tapping technology.

b. The seat ring shall be easily replaceable without special tools.

3. Stem: Shall be constructed of oxy-nitride coated type 316 Stainless Steel.

a. The stem shall be guided in two locations by means of easily replaceable bearing bushings.

4. Resilient Disc (Seat Seal): Shall be constructed of EPDM.

a. The resilient disc shall form a drip tight seal against the seat ring.

5. Diaphragm: Shall be constructed of EPDM.

a. Valve(s) with 8" and smaller ports shall provide smooth "frictionless" motion with actuation being achieved by the use of a

flat EPDM diaphragm and shall be constructed of nylon fabric bonded with synthetic rubber.

b. Valve(s) with 10" and larger ports shall provide smooth "frictionless" motion and maximum low flow stability with actuation being achieved by the use of the rolling diaphragm technology.

c. The diaphragms shall not be used as a seating surface. No lip seals or packing may be used to seal the valve.

6. Fasteners, External: Shall be constructed of 18/8 or 304 Stainless Steel.

2.02 CONTROL VALVE

A. Operation:

1. The Control valve shall be positioned by operation of the opening and closing solenoid valve via pump station PLC. Provide manual bypass valves around the solenoids valves for emergency operation.

2. The valve shall control the high water level in the water storage tank while sustaining inlet pressure and designed for high pressure drop capability of 70 psi to atmosphere through the use of two multi-orifice stainless steel sleeves within the valve body. The sleeves shall have sufficient number of round orifices for the pressure and flow requirements. Preliminary set point for pressure sustaining is 35 psi. The valve shall be suitable for continuous operation with a maximum flow rate of 8,000 gpm.

3. The valve shall be provided and installed with all accessories and appurtenances necessary for a complete operable system. Accessories shall include pilots for reservoir filling, enable/close 120VAC solenoid valve (energize to open altitude valve, the valve will close when the solenoid is de-energize), pressure sustaining pilot, fully closed limit switch, valve position indicator, 4/20 mA analog position transmitter - Singer X156, arion strainers and isolation valves, open/close micrometer needle speed control valve, inlet and outlet pressure gauges, and all miscellaneous tubing.

4. Provide hydraulically operated pilot to close valve based on reservoir water pressure independent of solenoid valve operation to close valve at high reservoir water level. Pipe reservoir sensing line directly to reservoir.

5. Provide lockable SST ball valve and plug to purge any air that may become trapped within the bonnet and stem cap.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install valve(s) as shown on Plans and in accordance with manufacturers' and City's requirements.

B. When the valve is mounted in a horizontal line, the stem shall be installed vertically to reduce unnecessary wear on the guide, and to facilitate easy removal and replacement of the inner valve assembly.

C. The valve manufacturer shall provide the required start-up service to check installation and operation of the valve. A total of 2 trips, 1 day each trip shall be included for start-up services. Service shall be provided by the valve

manufacturer or authorized representative and shall not be a third party sub-contractor.

D. The Contractor shall be capable of providing the required flow to the valve prior to start-up services.

END OF SECTION

SECTION 15410

PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes the following plumbing fixtures and related components for installation of plumbing systems:

1. Faucets for lavatories.
2. Lavatories.
3. Water heaters
4. Water closets, flushometers, and seats
5. Fixture supports.
6. Floor sinks and floor drains.
7. Trap seal primers.
8. Cleanouts.
9. Emergency fixtures.

B. Contractor shall furnish all materials, equipment, labor and incidentals necessary to furnish and place in operation completely functional plumbing and piping systems, including all accessories as shown on the Plans and as specified herein.

1.02 DEFINITIONS

A. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads, drains and tailpieces, and traps and waste pipes.

B. FRP: Fiberglass-reinforced plastic.

C. PMMA: Polymethyl methacrylate (acrylic) plastic

1.03 QUALITY ASSURANCE

A. Work under this Section shall be performed in accordance with the 2013 California Plumbing Code, and in accordance with applicable laws and regulations.

B. Where provisions specified according to these Specifications or as indicated on the Drawings are in conflict with the plumbing code specified or laws or regulations, the Code and the laws or regulations take precedence over the specified provisions and design.

C. All devices and fixtures supplied for projects in the State of California shall comply with Title 24 of the California Code of Regulations.

D. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer. If fixtures, faucets,

or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

F. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

G. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

H. Select combinations fixtures and trim, faucets, fittings, and other components that are compatible.

I. Comply with the following applicable standards and other requirements specified for plumbing fixtures, faucets, emergency fixtures, and miscellaneous fittings and components:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Vitreous-China Fixtures: ASME A112.19.2M.
3. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Supply Fittings: ASME A112.18.1.
11. Brass Waste Fittings: ASME A112.18.2.
12. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
13. Faucets: ASME A112.18.1.
14. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
15. Hose-Coupling Threads: ASME B1.20.7.
16. Manual-Control Antiscald Faucets: ASTM F 444.
17. Pipe Threads: ASME B1.20.1.
18. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
19. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
20. Emergency Eyewash and Shower Equipment: ANSI Z358.1.

21. Atmospheric Vacuum Breakers: ASSE 1001.

22. Brass and Copper Supplies: ASME A112.18.1.

23. Flexible Water Connectors: ASME A112.18.6.

24. Manual-Operation Flushometers: ASSE 1037.

25. Brass Waste Fittings: ASME A112.18.2.

26. Hose-Coupling Threads: ASME B1.20.7.

27. Off-Floor Fixture Supports: ASME A112.6.1M.

28. Pipe Threads: ASME B1.20.1.

29. Plastic Toilet Seats: ANSI Z124.5.

J. Available Manufacturers: Manufacturers offering products that may be incorporated into the Work include manufacturer's listed products as specified, subject to compliance with specified requirements.

1.04 SUBMITTALS

A. Prepare submittals in accordance with Section 01330. Complete assembly and installation drawings, together with detailed specifications and data covering materials used, parts, devices, and other accessories shall be submitted. The data and specifications for plumbing fixtures shall include, but shall not be limited to, the following.

1. Product Data: For each type of plumbing fixture indicated, include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

2. Electrical Diagrams: Diagram all power, signal, and control wiring required for electrically operated water heaters and other electrically operated plumbing components.

3. Operation and Maintenance Data: Include operation and maintenance manuals for all operable plumbing fixtures and plumbing fixtures requiring maintenance.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Lavatory Faucets

1. Faucet for lavatory-type plumbing fixture: Coordinate faucet inlets with supplies, connectors, and fixture holes; coordinate outlet with spout and fixture receptor.

a. Maximum Flow Rate: 1.5 gpm.

b. Body Material: Solid brass, lead-free.

c. Finish: Polished chrome plate.

d. Type: Two-handle mixing.

e. Tempering System: Not required.

f. Supply Centers: Match hole quantity and spacing of lavatory.

g. Mounting: Deck, concealed.

h. Handle(s): Wrist blade, 4 inches.

i. Temperature Indicators: Color-coded for hot and cold water.

j. Inlet(s): NPS 3/8 tubing, plain end or with NPS 1/2 (DN 15) male adaptor, NPS 1/2 male or female shank, as required.

k. Spout: Rigid, brass.

l. Spout Outlet: Aerator.

m. Operation: Non-compression, manual.

n. Drain: Not applicable.

2. Manufacturers, or equal:

a. American Standard Companies, Inc., 5400.172H or equivalent.

b. Kohler Co., K-7401-5A-CP or equivalent.

c. Zurn Industries, Inc, Z812F4-XL or equivalent.

B. Lavatories

1. Lavatories: Vitreous-china lavatory plumbing fixture suitable for wall mounting or counter mounting as indicated on the Drawings.

a. Wall Mounted:

1) Type: With back.

2) Size: 20 by 18 inches, rectangular.

b. Counter Mounted:

1) Type: Self-rimming.

2) Rectangular Lavatory Size: 20 by 18 inches.

c. Faucet Hole Punching: Three holes, center spacing as required.

d. Faucet Hole Location: Top.

e. Color: White.

f. Faucet: Lavatory for separate drain.

g. Supplies: NPS 3/8 chrome-plated copper tubes or flexible connectors with stops.

h. Drain: Grid.

i. Drain Piping: NPS 1-1/4, or NPS 1-1/4 by NPS 1-1/2, chrome-plated, cast-brass P-trap; NPS 1-1/2, 0.032-inch-0.045-inch-thick tubular brass waste to wall; and wall escutcheon.

j. Fixture Support: Lavatory.

2. Manufacturers, or equal:

a. American Standard Companies, Inc., Lucerne 0356 Series (wall mount only).

b. Kohler Co., Kingston or Hudson Series (wall mount), or Archer Series (counter mount).

c. Zurn Industries, Inc., Z5360 Series (wall mount only).

C. Water Heaters

1. Tankless electric water heaters

   a. Flow capacity: 1.5 gpm.
   b. Minimum temperature rise at flow capacity: 38 degrees F.
   c. Activation minimum flow: 0.5 gpm.
   d. Mounting: Wall or vertical face of cabinet interior.
   e. Heat exchanger: Brass/copper.
   f. Inlet and outlet connections: NPS 1/2.
   g. Temperature control: Externally adjustable temperature operating dial and/or pushbuttons.
   h. Display indication: Active and standby LED indication.
   i. Electrical requirements: 208-VAC, 1-phase, 60-Hz.
   j. Maximum allowable power consumption: 9.0 kW.
   k. Certification: UL listed.

2. Manufacturers, or equal:

   a. Stiebel Eltron, Tempra 12.
   b. Eemax EX8208 or SP8208

D. Water Closets

1. Bowl:

   a. Floor mounted, floor outlet, close coupled (flushometer tank), vitreous china bowls.
   b. Standards: ASME A112.19.2/CSA B45.1 and ASME A112.19.5.
   c. Bowl Type: Siphon jet.
   d. Height: Standard.
   e. Rim Contour: Elongated.
   f. Water Consumption: Low.
   g. Color: White.

2. Flushometer:

   a. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, and copper or brass tubing, and polished chrome-plated finish on exposed parts.
   b. Internal Design: Diaphragm operation.
   c. Style: Exposed.
   d. Inlet Size: NPS 1-1/4.
   e. Trip Mechanism: Oscillating, lever-handle actuator.
   f. Consumption: 1.28 gal./flush.
   g. Tailpiece Size: NPS 1-1/4 and standard length to top of bowl.

3. Toilet Seat:

   a. Standard: IAPMO/ANSI Z124.5.
   b. Materials: Molded plastic, with non-corroding metal hinges.

c. Configuration: Regular or elongated as required to be compatible with the bowl rim, with open front, and with cover.

d. Color: White

4. Manufacturers, or equal:

a. Bowls

1) American Standard, Madera 15”.

2) Kohler Co., K-4406-0 Wellworth.

b. Flushometers

1) American Standard, FloWise.

2) Kohler Co.

c. Seats

1) Bemis Manufacturing Company.

2) Kohler Co., K-4731-C-0 Stronghold.

E. Fixture Supports

1. Lavatory Supports: Type II, lavatory carrier with concealed arms and tie rod for wall-mounting, lavatory-type plumbing fixture. Include steel uprights with feet.

2. Manufacturers, or equal:

a. Josam Company, 17120.

b. Zurn Industries, Inc., Z-1254.

F. Floor Sinks and Floor Drains

1. Floor Sinks:

a. Floor sinks for interior locations or at locations which are not subject to rainwater or stormwater intrusion shall be cast iron with acid resistant enamel interior and exterior coating, no-hub or hubless outlet, with full, half, or quarter removable top grate, 12 inches square by 8 inches deep.

b. Floor sinks for exterior locations other than above shall be supplied with full top grate and surrounded by a square reinforced concrete pad, 24 inch thick, 2 inches above final grade or surrounding finished surface.

c. Pad shall extend 6 inches horizontally beyond the perimeter of the sink. Pad reinforcement shall consist of three horizontal #4 hoop bars on 6” centers, each 2½ to 3 inches from the outer edges of the pad, a #4 vertical bar on each vertical corner, four total.

d. Manufacturers, or equal:

a) Josam Company, 49340A.

b) Zurn Industries, Inc., Z-1901.

2. Floor Drains:

a. Floor drains shall be shall be cast iron with acid resistant enamel interior and exterior coating, adjustable height frame, floor level

nickel bronze waffle grid or circular grid type top grate with no-hub or hubless outlet.

b. Manufacturers, or equal:

1) Josam Company, 30000-A.

2) Zurn Industries, Inc., ZN-415 with type B or BZ strainer.

G. Trap Seal Primers

1. Trap seal primers shall be located as shown on the Drawings, and plumbed to trap seal connection fittings on drainage fixtures per plumbing code and manufacturer requirements. Route ½ inch copper piping from the trap seal primers to the traps. All trap seal primers shall be mounted in an accessible location.

2. Manufacturers, or equal:

a. Josam Mfg. Co., Model 88250

b. Zurn Industries, Inc., Model Z-1022

H. Cleanouts

1. Cleanouts shall be located as shown on the Drawings, and shall be installed in locations which will remain accessible upon the start of use of the associated piping system, and up to and upon the completion of construction.

2. Interior Floor Cleanouts:

a. Cleanouts located in interior finished floor areas shall be coated cast iron bodied, with gas and watertight ABS tapered thread plug, round scoriated nickel bronze secured top, adjustable to finished floor.

b. Manufacturers, or equal:

1) Josam Company, 55000-1.

2) Zurn Industries, Inc., ZN-1400.

3. Unfinished Ground and Exterior Grade Cleanouts

a. Cleanouts located in unfinished ground areas, or exterior grade areas shall be coated cast iron bodied, with gas and watertight ABS tapered thread plug, round scoriated nickel bronze heavy-duty secured top, adjustable to finished floor, level, or grade.

b. Cleanouts which are not already to be located in concrete slabs or pads as shown on the Drawings, shall be surrounded by a square or circular 8 inch thick reinforced concrete pad flush with final grade.

c. Pad shall extend 12 inches horizontally beyond the diameter of the cleanout. Pad reinforcement shall consist of two #4 hoop bars, each 4 inches from the inner or outer edges of the pad, and centered along the depth/height of the pad.

d. Manufacturers, or equal:

1) Josam Company, 55000-1-SD.

2) Zurn Industries, Inc., Z-1400-HD.

4. Wall Cleanouts and Cleanouts Located on Vertical Piping:

   a. Cleanouts located on vertical piping shall be of cast iron with a threaded bronze plug. Cleanouts for vertical piping located in walls shall also include a smooth, round stainless steel access cover secured to the plug with a screw.

   b. Manufacturers, or equal:

      1) Josam Company, 58910 (no access cover) or 58600-COT (with access cover).

      2) Zurn Industries, Z1446.

I. Emergency Fixtures

1. Combination Shower/Eyewash Units: Each combination emergency shower and eyewash unit shall be constructed of 1¼" schedule 40 hot-dipped galvanized steel pipe and fittings and shall have the following features and components:

   a. 8" diameter plastic showerhead with integral flow control, 1" chrome-plated brass full-flow stay-open ball valve, and a minimum 24" long stainless steel pull rod with triangular handle.

   b. Eyewash with corrosion-resistant (stainless steel or chrome-plated brass) yoke with twin anti-surge eyewash heads with integral flow control and protective eyewash head covers, a ½" chrome-plated brass full-flow stay-open ball valve, and highly-visible push handle.

   c. 9” diameter powder coated cast iron or cast aluminum floor mounting flange.

   d. Identification sign, ANSI compliant.

   e. Standard: ANSI Z358.1 Standard for Emergency Eyewash and Shower Equipment.

   f. Manufacturers, or equal:

      1) Haws Corporation, 8320-8325.

      2) Guardian Equipment Co., G1902P.

2. Combination Shower/Eyewash Units – Non-Freeze Type: Each combination emergency shower and eyewash unit located outdoors subject to freezing temperatures, shall include all of the features and components of Combination Shower/Eyewash Units as list above, in addition to the following:

   a. Thermostatically controlled electric heat traced cable.

   b. Removable ¾" foam insulation and an ABS plastic green jacket with elastomeric seals for all seams and openings in the jacket that prevents freezing down to ambient temperatures of 15°F.

   c. Manufacturers, or equal:

      1) Haws Corporation, 8317CTFP.

      2) Guardian Equipment Co., GFR3110.

3. Accessories:

1) Flow switch: 1¼", 5 AMP, 125 VAC, SPDT flow switch, activated upon usage of the eyewash or shower or both, Class 1, Division 1, Group B, C, D explosion-proof, and UL Listed.

2) Manufacturers, or equal:

a) Haws Corporation, SP154DPDT.

b) Guardian Equipment Co., AP275-615.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for plumbing fixtures to verify actual locations of piping connections before fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.

2. Use carrier supports without waste fitting for fixtures with tubular waste piping.

C. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.

E. Install counter-mounting fixtures in and attached to casework.

F. Install fixtures level and plumb according to roughing-in drawings.

G. Install water-supply piping with stop on each supply to each fixture to be connected to domestic water piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation. Use ball, gate, or globe valve if stops are not specified with fixture. Valves are specified in Section 15100 "Valves and Appurtenances."

H. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

I. Install cleanouts located as shown on the Drawings, and mounted in an areas which will remain accessible upon the start of use of the associated piping, and up to and upon the completion of construction.

J. Install flushometer valves for water closets with handle mounted on wide side of compartment or away from the nearest wall or corner.

K. Install toilet seats on water closets.

L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

M. Install electric or gas on-demand type water heaters below high points of the outlet piping to allow for any entrained air bubbles the water flow to pass through the unit. Do not install heaters in locations which are subject to routine splashing and water spray.

N. Install traps on fixture outlets except for fixtures with integral traps.

O. Install escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.

P. Seal joints between fixtures and walls, floors, and counters using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

Q. Install Emergency Showers and Combination Units secured in place with floor carriers and bolts.

R. Emergency fixtures shall be mounted to the following heights above finished floor:

1. Emergency Eye/Face Wash: Standard height 38 inches to receptor rim.

2. Emergency Shower: Standard height 84 inches to bottom of head.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from domestic water piping to plumbing fixtures.

C. Connect drain piping from plumbing fixtures to sanitary waste and vent piping.

D. Ground equipment and connect wiring according to Section 16120 “Low Voltage Wire and Cable & Grounding.

3.04 QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.05 FIELD ADJUSTMENT

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning plumbing fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream without splashing, overflow or unusual noise.

3.06 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.

B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

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SECTION 15731

HEATING, VENTILATION, AND AIR CONDITIONING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes the heating, ventilation and cooling system for the control building's electrical, chlorine, fluoride, storage rooms along with the restroom. The following will be heated and/or cooled:

1. Electrical Room: Heated and cooled
2. Chlorine room: Heated only, fan vented outside, and louver vents
3. Fluoride room: Heated only, fan vented outside, and louver vent
4. Storage room: Wall heater, ceiling exhaust fan, and louver vent
5. Fire riser room: Wall heater, ceiling exhaust fan, and louver vent
6. Restroom: Wall heater, ceiling exhaust fan, and louver vent

B. The chlorine and fluoride rooms will have separate heating and ventilation systems and be completely separate from the other rooms with no air changes transferred with any other rooms in the building.

C. Electrical Room (Two Units):

1. The electrical room shall be heated and cooled from two ductless heat pump split systems with the following operating conditions:

Electrical Room - Heating and Cooling (total of both units)		
Cooling Capacity (BTU/hr)	Heating Capacity (BTU/hr)	Electrical Voltage /phase
60,000	64,000	240 /1

D. Chlorine and Fluoride Rooms:

1. Heating System:

a. The chlorine and fluoride rooms shall have ceiling mounted heaters to prevent each room from freezing during the winter months with the following operating conditions.

Chlorine/Fluoride Room - Heating System (per unit)	
Heating Capacity (BTU/hr)	Electrical Voltage /phase
6,800	240 /1

2. Ventilation System:

a. The chlorine and fluoride rooms shall have continuously operating louvered exhaust fans installed and fixed louver vents. The ventilation system will have the following operating conditions.

Chlorine/Fluoride Room - Ventilation System (per unit)	
Ventilation CFM	Electrical Voltage /phase
300/360	120 /1

E. Storage Room, Fire Riser Room, and Restroom:

1. Heating System:

a. The storage room, fire riser room, and restroom shall have a wall mounted heater to prevent each room from freezing during the winter months with the following operating conditions.

Restroom, Storage, and Fire Riser Room Heating System (per unit)	
Heating Capacity (BTU/hr)	Electrical Voltage /phase
6,800	240 /1

2. Ventilation System:

a. The storage room, fire riser room, and restroom shall each have a ceiling exhaust fan that vents air outside through the attic along with an exterior wall vent located near the floor of the room. The exhaust fan will be wired to a switch located next to the each room's entrance door. The venting will be used to remove excess heat or odors that may accumulate in the room.

Storage Room, Fire Riser Room, and Restroom - Ventilation System (per unit)	
Ventilation CFM	Electrical Voltage /phase
130	120 /1

1.02 REFERENCES

Reference	Title
AMCA	Certified Ratings Program
ARI 210/240	Unitary Air Conditioning and Air Source Heat Pump Equipment
ARI 340/360	Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment
ARI 365	Commercial and Industrial Unitary Air Conditioning Condensing Units
NFPA 70	National Electrical Code (NEC)
NFPA 90A	Installation of Air Conditioning and Ventilation Systems
UL 456	Central Cooling and Air Conditioners
NFPA 90A	Standard for Installation of Air Conditioning and Ventilating Systems

1.03 QUALITY ASSURANCE

A. Provide all material and perform all work in accordance with all applicable codes, agency standards and manufacturers' written instructions.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.) and local codes as required.

1.04 DELIVERY, STORAGE AND HANDLING.

A. The equipment shall be stored and handled according to the manufacturer's recommendations.

B. The controller shall be shipped separately and shall be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

1.05 SUBMITTALS

A. Submit in accordance with Section 01330.

B. Shop Drawings and Product Data: Submit the following as a single complete initial submittal:

1. Product data to demonstrate that the equipment conforms to the Specifications
2. Motor data and fan performance curve
3. Layouts and dimensions
4. Complete assembly and application drawings with detailed instructions.
5. All permits, test and balance reports, warranties, certifications, inspection reports.
6. Manufacturer's installation, operations and maintenance manuals, bulletins, and spare parts lists.

C. Affidavits: Submit affidavit from the manufacturer stating that the equipment has been properly installed, and tested and is ready for operation.

PART 2 - PRODUCTS

2.01 GENERAL

A. Each air system shall have the following features:

B. Electrical Room (Heating and Cooling)

1. Two heat pump systems with a minimum heating and cooling capacity of 30,000 btu/hr each for a total of 60,000 btu/hr.
2. Ductless with combination indoor and outdoor units
3. Indoor units shall be surfaced mounted on the ceiling
4. Outdoor inverter units shall be anchored to a concrete pad adjacent to the control building's electrical room as shown on the plans.
5. Manufacturer:
   a. Mitsubishi PLA-A30BA4 (indoor unit) and PUZ-A30NHA4 (outdoor unit) with PAR-21MAA Wired Controller
   b. Or an approved equivalent
6. Contractor to coordinate with the roof trusses to box the indoor unit into the ceiling.

C. Chlorine Room Heating Systems (two systems) and Fluoride Room Heating System (one system):

1. Heater minimum heating capacity of 6,800 btu/hr.
2. Ceiling mounted
3. Manufacturer:
    a. Trane Model UHCA Heater with unit mounted thermostat
    b. Or an approved equivalent

D. Chemical Rooms – Ventilation System (two systems) – Chlorine and Fluoride Rooms:

1. Ventilation Fan
    a. 8” Shutter Mounted Exhaust Fan by Canarm Model LFI-AX08-3 or an approved equivalent
    b. Two Speed Manual Control Switch
    c. Air Flow = 300/360 CFM
    d. Fan mounted in CMU wall by Contractor
    e. Fan located 4-inches above the floor slab
2. Wall Ventilation (two for Chlorine Room, one for Fluoride Room)
    a. Fixed Extruded Aluminum Louver
    b. Storm Proof for exterior wall installation with bug screen
    c. Vent located 4-inches above the floor slab

E. Storage Room, Fire Riser Room, and Restroom – Ventilation System (three systems)

1. Ventilation Fan
    a. NuTone Ultra Silent 130 CFM exhaust bath fan, Energy Star Qtn130 or equivalent
    b. Air Flow = 130 CFM
    c. Fan mounted in ceiling and vented outside through the attic
2. Exterior Wall Ventilation (near floor)
    a. Fixed Extruded Aluminum Louver
    b. Storm Proof for exterior wall installation with bug screen
    c. Vent located 4-inches above the floor slab

F. Storage Room, Fire Riser Room, and Restroom – Heating System (three systems)

1. Heater minimum heating capacity of 6,800 btu/hr.
2. Wall mounted
3. Manufacturer:
    a. Trane Model UHWA Heater with unit mounted thermostat
    b. Or an approved equivalent

2.02 VIBRATION ISOLATION

A. Installation of all vibration materials and supplemental equipment bases specified shall be accomplished following the manufacturers written instructions.

2.03 ELECTRICAL

A. Electrical Room:

1. There will be two heat pump systems that operate in parallel with each other to heat and cool the electrical room.
2. Each system shall consist of an indoor unit, outdoor unit and wall mounted thermostat.
3. The electrical power of the outdoor units shall be 230 volts, single phase, and 60 hertz.
4. Power for the indoor unit shall be supplied from the outdoor unit
5. Each outdoor unit shall be controlled by the microprocessor located in the indoor unit.
6. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC.
7. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

B. Chemical Rooms (Chlorine and Fluoride):

1. Heat System:
   a. The electrical power of each heater shall be 240 volts, single phase, and 60 hertz.
   b. Each heater will be controlled from a unit mounted thermostat
2. Ventilation System
   a. The electrical power of the ventilation fan shall be 120 volts, single phase, and 60 hertz.
   b. The ventilation fan will be controlled from a two speed controller mounted on the wall.

C. Storage Room, Fire Riser Room, and Restroom:

1. Heat System:
   a. The electrical power of the heater shall be 240 volts, single phase, and 60 hertz.
   b. The heater will be controlled from a unit mounted thermostat
2. Ventilation System
   a. The electrical power of the ventilation fan shall be 120 volts, single phase, and 60 hertz.
   b. The ventilation fan will be controlled from a switch located adjacent to the entrances to each room.

2.04 WARRANTY

A. Heat Pump Systems (Electrical Room):

1. The units shall have a manufacturer's parts and defects warranty for a period five (5) years from date of installation. The compressor shall have a warranty of seven (7) years from date of final acceptance.

B. Heaters (Chlorine and Fluoride Rooms):

1. The units shall have a manufacturer's parts and defects warranty for a period of one (1) year from the date of final acceptance.

C. Ventilation Fans (Chlorine and Fluoride Rooms):

1. The units shall have a manufacturer's parts and defects warranty for a period of one (1) year from the date of final acceptance.

D. Exhaust Fans (Storage Room, Fire Riser Room, and Restroom):

1. The units shall have a manufacturer's parts and defects warranty for a period of one (1) year from the date of final acceptance.

E. Heaters (Storage Room, Fire Riser Room, and Restroom):

1. The units shall have a manufacturer's parts and defects warranty for a period of one (1) year from the date of final acceptance.

2.05 NOISE LEVEL

A. The two heat pumps' sound level shall not exceed 55 dBA when cooling and 55 dBA when heating from a measured distance of 20 feet from the units in any direction.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Units shall be aligned, connected, and installed at the location specified on the plans and in accordance with the manufacturer's written recommendations. The units shall be installed and tested under the direction of factory-trained personnel.

B. Perform HVAC penetrations in accordance with NFPA 90A.

C. The HVAC supplier will be responsible for the conduit and wiring between the units and controller.

D. The electrical contractor will be responsible for providing power to the HVAC units.

3.02 FIELD TESTING

A. After completion of installation, heat pump, heaters, ventilation fans and exhaust fans shall be field tested to demonstrate compliance with the manufacturer's published performance as specified herein.

B. Testing procedures shall duplicate as nearly as possible the conditions of operation and shall be selected to demonstrate that the equipment is operational and free from damage.

C. Each control device, item, or mechanical, electrical, and instrumentation equipment, and control circuits shall be considered in the testing procedures to demonstrate that the equipment has been properly serviced, aligned, connected, calibrated, and adjusted prior to operation.

END OF SECTION

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SECTION 16050

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. General requirements applicable to all Electrical Work.
2. General requirements for electrical submittals.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

   a. Section 01105 – General Information and Requirements.
   b. Section 01110 – Summary of Work.
   c. Section 01140 - Work Sequence and Constraints.
   d. Section 01310 - Project Meetings.
   e. Section 01330 - Submittals.
   f. Section 01410 - Quality Control.
   g. Section 01500 – Construction Facilities and Temporary Controls.
   h. Section 01600 – Material and Equipment.
   i. Section 01662 – Commissioning.
   j. Section 01750 - Testing, Training, and Facility Start-Up.
   k. Section 01770 – Contract Closeout.
   l. Section 01780 - Operation and Maintenance Data.
   m. Section 01781 – Warranties and Bond.
   n. Section 01900 - Seismic Design Criteria.
   o. All concrete and steel reinforcement work in Division 03.
   p. Section 05501 – Anchor Bolts.
   q. All motor driven equipment in Divisions 11, 13, 14, and 15.

r. All Sections in Division 16.

s. All Sections in Division 17.

C. Interfaces to equipment, instruments, and other components:

1. The Drawings, Specifications, and overall design are based on preliminary information furnished by Specification named equipment manufacturers which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to: electrical equipment, network switches, instruments, control devices, packaged mechanical systems, and control equipment provided with mechanical systems.

2. CONTRACTOR is responsible to provide all electrical work to install vendor supplied equipment. Vendor supplied equipment and/or components of vendor supplied packaged systems may not be represented entirely on the Drawings and it is the CONTRACTOR's responsibility to furnish all electrical work for a complete and operable system. This includes but is not limited to; system design, layout of equipment, approved working clearances, conduits, cables, supports, disconnects, j-boxes, labels, tags, testing, etc., per the Contract Specifications. Vendor is responsible for submittal of and obtaining approval of; interconnect drawings detailing conductor sizes and conduit sizes complete with tagging and labeling, equipment mounting details complete with heights and clearances.

3. Provide all material and labor needed to install the actual submitted and approved equipment furnished, and include all costs to add any additional conduit, wiring, terminals, or other electrical hardware to the Work, which may be necessary to make a complete, functional system based on the actual equipment furnished:

a. Make all changes necessary to meet the manufacturer's wiring and installation requirements.

b. Make all changes necessary to maintain manufacturer's warranty.

4. NEMA 12 areas may have wiring devices installed within recessed box (cast within wall) for flush mounted arrangement.

5. Wiring devices shall be installed within exposed surface mounted cast boxes with threaded fittings. Refer to Drawings if wiring device cast box is to be polyvinyl chloride coated.

6. Submit all such changes and additions to the ENGINEER for acceptance as specified in Section 01110.

7. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include any such items that appear on the Drawings or in the Specifications from another discipline in the scope of Work:

a. If a conflict between Drawings and Specifications is discovered, refer conflict to the ENGINEER as soon as possible for resolution.

D. All electrical equipment and systems for the entire Project shall comply with the requirements of the Electrical Specifications, whether referenced in the individual Equipment Specifications or not:

1. The requirements of the Electrical Specifications apply to all Electrical Work specified in other sections, including but not limited to HVAC controls, packaged mechanical systems, and vendor supplied equipment and interconnection of same, including vendor supplied control panels (VCP).

2. Inform all vendors supplying electrical equipment or systems of the requirements of the Electrical Specifications.

3. CONTRACTOR is responsible to provide conduit tags on all conduits unless specifically stated no tags are required.

4. CONTRACTOR is responsible to provide overall cables tags and individual wire tags on all conductors unless specifically stated no tags are required.

5. The OWNER is not responsible for any additional costs due to the failure of the CONTRACTOR to notify all subcontractors, suppliers, and vendors of the Electrical Specifications requirements.

E. Contract Documents:

1. General:

a. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work. Contract Drawings and Specifications are intended to be descriptive of the type of electrical system to be provided; any minor details missing in either shall not relieve the Contractor from the obligations thereunder to install in correct detail any and all materials necessary for a complete operational system at no additional cost.

2. Specifications:

a. The General and Supplementary Conditions of the Contract Documents govern the Work.

b. These requirements are in addition to all General Requirements.

3. Contract Drawings:

a. The Electrical Drawings show desired locations, arrangements, and components of the Electrical Work in a diagrammatic manner.

b. Locations of equipment, control devices, instruments, boxes, panels, raceways, ductbanks, etc. are approximate only; exercise professional judgment in executing the Work to ensure the best possible installation:

1) The equipment locations and dimensions indicated on the Drawings are approximate. Use the shop drawings to determine the proper layout, foundation and anchoring requirements, conduit windows, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all electrical equipment is compatible with other equipment and meets space requirements. Make changes required to accommodate differences in equipment dimensions.

2) The CONTRACTOR has the freedom to select any of the named manufacturers as identified in the individual

specification sections; however, the ENGINEER has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the CONTRACTOR's responsibility to ensure that the equipment being furnished fits within the defined space.

3) CONTRACTOR shall provide and install equipment per their vendor supplied system based on vendor's submitted and approved design.

4) CONTRACTOR shall provide and install equipment per their suppliers' system submitted designs, as approved by the ENGINEER, for Specification Sections 16500, 16710, and 16752.

5) The Contract Electrical elementary, elevation and one-line diagrams are the basis of the electrical system to be provided and are for reference only. It is the Contractor's responsibility to adjust and make minor revisions to the diagrams as necessary for operational system at no additional cost to the Owner. Additional isolators, relays, wiring, terminal blocks, and appurtenances, shall be provided for an operation system at no additional cost to the Owner. Contractor shall also modify starter size, breaker size, etc. at no additional cost to the Owner, if such changes are the direct result of the equipment selected by the Contractor.

6) Location at facilities of new equipment, inserts, anchors, panels, pull boxes, conduits, stub-ups, and fittings for the electrical system are to be determined by the Contractor and Engineer at time of installation. Contractor shall make minor adjustments to locations of electrical equipment required by conditions and coordination with other trades at no additional cost. Minor adjustments are defined as those adjustments required due to equipment size changes or variations between different equipment suppliers.

7) The Conduit and Wire Routing Schedule, wire fill, and number of conduits are based on the best information available. It is the Contractor's responsibility to modify the conduit schedule based upon Shop Drawings for the actual equipment. Such modifications in conduit sizes, conductor size and numbers of conductors shall be at no additional cost to the Owner and shall be approved by Owner, if such changes are the direct result of the equipment selected by the Contractor.

8) Electrical & Instrumentation, conduit & wire lengths shown on Contract Drawings are approximate and do not show changes in elevation or vertical risers. The Contractor is responsible for determining actual lengths for bidding and installation purposes.

9) Where conduits are shown as "home runs" on the Contract Drawings or stated to be furnished, but not explicitly shown as part of the scope of work, the Contractor shall provide all fittings, boxes, wiring, and appurtenances, as required for completion of the raceway system in compliance with the NEC and the applicable Specifications in this Section.

c. Installation details:

1) The Contract Drawings include typical installation details that the CONTRACTOR is to use to complete the Electrical Work. Installation details shall be followed even if not called out at specific installation location. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the ENGINEER.

2) CONTRACTOR shall install vendor supplied equipment per vendor submitted and ENGINEER approved installation details.

3) CONTRACTOR shall coordinate with suppliers' designs for equipment to be installed per Specification Sections 16500, 16710, and 16752; based on per suppliers' submitted and ENGINEER approved installation details.

d. Schematic diagrams:

1) All controls are shown de-energized.

2) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.

3) Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations. Change normally open contacts to normally closed contacts or vice versa where required. Add additional relays to provide more contacts as necessary.

4) Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.

5) Schematic diagrams are to be used in conjunction with the descriptive operating sequences in the Contract Documents. Combine all information and furnish a coordinated and fully functional control system.

6) CONTRACTOR is responsible to submit for approval complete schematic diagrams for vendor supplied panels.

F. Testing, Training, and Facility Start-Up:

1. Coordinate with Section 01662 and 01750 requirements.

2. CONTRACTOR is responsible for testing all electrical work.

3. CONTRACTOR is responsible for testing all electrical work installed as part of vendor packaged equipment as specified elsewhere, and suppliers' systems per Specification Sections 16500, 16710, and 16752.

4. Within Division 16 the term "Factory Testing" is the equivalent with "Performance Testing" described herein and 17050.

5. The procedures for electrical system testing, training and facility start-up shall follow the progression outlined in Section 01750:

   a. CONTRACTOR's submitted and approval of Start-Up Plan.

   b. Equipment "Factory Testing" ("Performance Testing") prior to equipment shipment.

   c. Equipment "General Start-Up and Testing".

      1) Cable megger tests.

      2) Cable hipot tests.

      3) Grounding resistance and continuity tests.

      4) Electrical Field Acceptance Tests per Section 16950.

      5) Visual check installation.

      6) Visual check nameplates, conduit and cable labels, arc-flash labels.

      7) Verify communication networks.

      8) Provide instrument calibration.

      9) Verify initial setpoints and trips on instruments.

      10) Verify initial ranges on instruments.

      11) Check interlocks, control circuits, alarms, and all measured parameters and settings.

      12) Verify settings of overcurrent protection devices and relays.

      13) Test switchboards, panelboards and transformers for proper operation.

      14) Motor rotation and measure full load ampacity.

      15) Others and order per approved CONTRACTOR'S Start-Up Plan.

   d. Equipment systems "Functional Testing" for 8 hours.

      1) Example of equipment system Functional Testing maybe Pump 1 where all the connected components have been through successful General Start-Up and Testing. These connected components such as the Switchboard, VFD, motor, pressure switch, all make up the Pump 1 system.

      2) Perform initial checks in the presence of and with assistance of the manufacturer's representative.

3) Verify all electrical interlocks, Kirk key systems, alarms, controls, etc.

4) Testing includes running the equipment system for 8 hours without failure. Failure shall be defined as part of approved CONTRACTOR'S Start-Up Plan.

e. "Certification of Proper Installation" by manufacturer's representative after successful Functional Testing.

f. "Training of OWNER'S Personnel."

g. Equipment systems 7 Day "Operational Testing."

1) Operational Testing shall not begin until training completed. 7-day Operational Testing to cover entire facility.

2) ENGINEER may approve 7 Day Operational Testing that cover multiple electrical systems. In above example the Pump 1 has its own specific Functional Testing, as does Pump 2, and 3, etc., but the entire Pump Station will have an Operational Test. This allowed grouping of electrical systems and processes will be clarified as part of the approval process with the CONTRACTOR's submitted Start-Up Plan.

3) Testing includes running the equipment system for 7 days without failure. Failure shall be defined as part of approved CONTRACTOR'S Start-Up Plan.

G. Alternatives:

1. Coordinate with Section 01600 for substitute item provisions.

H. Changes and change orders:

1. As specified in Section 01105.

1.02 REFERENCES

A. Codes and Standards compliance:

1. Electrical Work shall be in compliance with the following laws and codes:

a. Local Laws and Ordinances.

b. State and Federal Laws.

c. State Fire Marshal.

d. California Code of Regulations:

1) Title 24 Part 2 California Building Code.

2) Title 24 Part 3 California Electrical Code.

3) Title 24 Part 9 California Fire Code.

e. National Electrical Code (NEC) NFPA 70 - 2014.

f. National Electrical Code (NEC) NFPA 70E 2015.

g. National Electrical Safety Code (NESC).

2. The publications are referred to in the text by the basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of the bid governs.

3. The standards listed are hereby incorporated into this Section:

a. American National Standards Institute (ANSI).

b. ASTM International (ASTM).

c. Illuminating Engineering Society (IES) of North America.

d. Institute of Electrical and Electronic Engineers (IEEE).

e. Institute of Power Cable Engineers Association National Board of Fire Underwriters (NBFU).

f. Insulated Power Cable Engineers Association (IPCEA).

g. InterNational Electrical Testing Association (NETA).

h. International Society of Automation (ISA).

i. National Electrical Manufacturers Association (NEMA):

1) NEMA 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

j. National Fire Protection Association (NFPA):

k. National Institute of Standards and Technology (NIST).

l. National Electrical Contractor’s Association (NECA) Standard of Installation

m. Rules of the National Board of Fire Underwriters.

n. Safety Orders of Industrial Accident Commission.

o. Underwriters' Laboratories, Inc. (UL).

p. SMUD Requirements.

B. Compliance with Codes and Standards:

1. Wherever the requirements of the Specifications or Drawings exceed those of the above items, the requirements of the Specifications or Drawings govern. Code compliance is mandatory. Construe nothing in the Contract Documents as permitting work not in compliance with these codes.

2. Obtain all permits and pay all fees required by any governmental agency or utility having jurisdiction over the work. Arrange all inspections required by these agencies. On completion of work, furnish satisfactory evidence to the Engineer that the work is acceptable to the regulatory authorities having jurisdiction.

1.03 DEFINITIONS

A. Definitions of terms and other electrical and instrumentation considerations as set forth by:

1. IEEE

2. ISA

3. NEC

4. NEMA

5. NETA

6. NFPA

B. Specific definitions:

1. FAT: Factory Acceptance Test.

2. HMI: Human machine interface: SCADA node, typically a computer workstation.

3. ICSC: Instrumentation and controls subcontractor.

4. LCP: Local control panel: Operator interface panel that may contain pilot type control devices, control relays, etc. and does not contain a PLC or RIO.

5. PCIS: Process control and instrumentation system.

6. PCM: Process control module: An enclosure containing any of the following devices: programmable logic controller (PLC), remote terminal unit (RTU), or remote input/output (RIO). Also referred to as PLC Panel.

7. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.

8. Space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device but is capable of accepting a device with no modifications to the equipment, i.e., provide all standoffs, bus, and hardware, as part of the space.

9. Spare: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that physically contains a device with no load connections to be made.

10. Unequipped space: That portion of the switchgear, motor control center, panelboard, switchboard or control panel that does not physically contain a device, standoff, bus, hardware, or other equipment.

11. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, Operator interface panel (OIP), HMI, etc.

1.04 SYSTEM DESCRIPTION

A. General requirements:

1. The Work includes everything necessary for and incidental to executing and completing the Electrical Work indicated on the Drawings and specified in the Specifications and reasonably inferable there from:

a. The Electrical Drawings are schematic in nature; use the Structural, Architectural, Mechanical, and Civil Drawings for all dimensions and scaling purposes.

2. It is the intent of these Specifications that the entire electrical power, instrumentation, and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of equipment furnished by others as well as equipment furnished by the CONTRACTOR, whether or not specifically mentioned but which are necessary for successful operation.

3. Provide all Electrical Work, including conduit, field wiring, and connections by the electrical subcontractor under the provisions of the Electrical Specifications for all aspects of the Work, including heating, ventilating, and air conditioning.

4. Coordinate all aspects of the Work with the electrical subcontractor and other subcontractors before bidding in order to ensure that all costs associated with a complete installation are included. The OWNER is not responsible for any change orders due to lack of coordination of the Work between the CONTRACTOR, the electrical subcontractor, the other subcontractors, or suppliers.

5. CONTRACTOR is responsible to configure the following equipment prior to start up and testing. Configuration shall include the network IP address, as provided by the ENGINEER. Network addresses shall be included as part of submittals for approval. The CONTRACTOR is responsible to initially program and configure the equipment on the network to verify communication. The OWNER will provide programming for the PLC Panels after communication networks (fiber cables, Cat 6 cables, RS-485 cables, etc.) has been Field Acceptance Tested and certified acceptable.

   a. Switchboard, Motor Control Centers (MCCs) including all Ethernet switches, gateways and individual device addresses.

   b. Variable Frequency Drives (VFDs) complete.

   c. Reduced Voltages Solid State (RVSS) Starters complete.

   d. Power Monitoring equipment complete.

   e. Network Equipment including rack, servers, Ethernet switches, etc.

   f. PLC Panel networked devices including Ethernet switches, PLC communication modules.

   g. Vendor supplied equipment including all Vendor Control Panels with associated switches, PLCs, OIPs, etc.

6. PLC programming for non-vendor supplied PLCs shall be provided by CONTRACTOR. Refer to Division 17.

7. SCADA HMI programming shall be provided by CONTRACTOR. Refer to Division 17.

B. Utility Coordination: Coordinate with the electric and telephone utilities as required by Section 16210.

C. Existing systems and modifications:

1. Radio link to existing City Facility. Provide field radio site survey between Shasta PS and preferred monitoring location. If link fails, install duplicate

network system equipment (per Division 17 and Drawing E9) at alternate location at no additional charge to OWNER. Monitoring location in descending order of preference:

a. Meadowview

b. CWTP

c. Brighton Heights

d. Florin Reservoir.

D. New major electrical equipment systems and work:

1. Provide all electrical work including low voltage equipment and systems, instrumentation, panels, lighting and receptacles at new Shasta Control Building, new Water Well, new Methane Treatment System, new Manganese Filters, new Backwash Recycle System, new Chemical Systems, new Water Storage Tank, new Booster Pump Station and site at Shasta Park Water Facility as shown on Drawings.

2. Provide all electrical work including low voltage equipment and systems, instrumentation, panels, at remote radio location as determined above as shown on Drawings.

E. Operating facility:

1. The remote radio location is an operating facility. The facility shall remain functional throughout the construction period with only intermittent, planned, scheduled, and OWNER approved reductions in process flow or shutdowns. In consideration of this requirement, comply with the following guidelines:

a. All outages must be of minimal duration and fully coordinated and agreed to by the OWNER. Adjust the construction schedule to meet the requirements of the OWNER. All changes in schedule and any needs to reschedule are included in the Work.

b. As weather and water demand conditions dictate, re-adjust the construction schedule to meet the demands placed upon OWNER by its users.

c. Coordinate the construction and power renovation and bear all costs, so that all existing facilities can continue operation throughout construction.

2. The standards of documentation, nameplates, instrument tagging, conduit and cable labels and terminal identification that apply to the new installation apply equally to the modifications of existing equipment which forms part of the modified system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330, Section 17050 and this Section.

B. General:

1. Provide manufacturers' descriptive information and shop drawings for all equipment, material, and devices furnished under Division 16, including

equipment specific outline and arrangement drawings, schematic diagrams, interconnection diagrams, and grounding requirements. Catalog data sheets for mass produced, non-custom manufactured materials are acceptable. Catalog data sheets shall be stamped to indicate project names, applicable section and paragraph, model number and options

2. Submit schematic drawings for all equipment furnished, including VCPs. These drawings shall contain terminal numbers, device names and tag numbers, wire numbers, etc., to provide complete identification of the circuits. Manufacturer's standardized schematic diagrams will not be acceptable.

3. Submit Interconnect drawings for all equipment furnished, including VCPs. These drawings shall contain terminal numbers, device names and tag numbers, wire numbers, wire size, conduit number, pull boxes, j-boxes, etc.

4. Instruct all equipment suppliers of submittals and operation and maintenance manuals of the requirements in this Section.

5. Furnish the submittals required by each section in the Electrical Specifications.

6. Adhere to the wiring numbering scheme shown on the Drawings and specified in Section 16075 throughout the Project:

    a. Uniquely number each wire.

    b. Wire numbers must appear on all Equipment Submittal Drawings.

7. Use equipment and instrument tags, as indicated on the Drawings, for all submittals.

8. A copy of the appropriate Division Specification Sections, with addendum updates included and with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

    a. Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore, requested by the Contractor, each deviation shall be underlined and denoted by a unique number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the Specifications.

    b. The submittal shall be accompanied by a detailed, written justification for each numbered item explaining variance or non-compliance with specifications.

    c. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no review.

9. Request for information (RFIs) shall not be included in submittals. RFIs shall be submitted separately in its individual submittal number.

C. Submittal organization:

1. Submittal format shall be as specified in Section 01330 and Section 17050.

D. Submittal requirements:

1. Furnish submittals that are fully indexed with a tabbed divider for every component.

2. Sequentially number pages within the tabbed sections. Submittals and operation and maintenance manuals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.

3. Edit all submittals and operation and maintenance manuals so that the submittal specifically applies to only the equipment furnished.

   a. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.

4. Submit copies of shop drawings, and product data:

   a. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.

5. Where submittals are required, provide a separate submittal for each specification section. In order to expedite construction, the CONTRACTOR may make more than one submittal per specification section, but a single submittal may not cover more than 1 specification section:

   a. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section. (For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.)

6. Exceptions to Specifications and Drawings:

   a. Include a list of proposed exceptions to the Specifications and Drawings along with a detailed explanation of each.

   b. If there is insufficient explanation for the exception or deviation, the submittal will be returned requiring revision and re-submittal.

   c. Acceptance of any exception is at the sole discretion of the ENGINEER.

      1) Provide all items (materials, features, functions, performance, etc.) required by the Contract Documents that are not accepted as exceptions.

   d. Replace all items that do not meet the requirements of the Contract Documents, which were not previously accepted as exceptions, even if the submittals contained information indicating the failure to meet the requirements.

7. Specific submittal requirements:

a. Shop drawings:

1) Required for materials and equipment listed in this and other sections.

2) Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.

3) Shop drawings requirements:

a) Front, side, backpan, and, rear elevations, and top and bottom views, showing all dimensions and drawn to scale.

b) Locations of conduit entrances and access plates.

c) Component layout and identification.

d) Schematic and wiring diagrams with wire numbers and terminal identification.

e) Interconnect diagrams with wire numbers, conduit numbers, terminal identification, manholes, handholes, j-boxes, etc.

f) Anchoring method and leveling criteria, including manufacturer's recommendations for the Project site seismic criteria.

g) Weight.

h) Finish.

i) Nameplates:

(1) As specified in Section 16075.

j) Temperature limitations, as applicable.

k) Latching mechanism.

l) Fans and ventilation system.

b. Product data:

1) Submitted for non-custom manufactured material listed in this and other sections and shown on shop drawings.

2) Include:

a) Catalog cuts.

b) Bulletins.

c) Brochures.

d) Quality photocopies of applicable pages from these documents.

e) Identify on the data sheets the Project name, applicable specification section, and paragraph.

f) Identify model number and options for the actual equipment being furnished.

g) Neatly cross out options that do not apply or equipment not intended to be supplied.

c. Detailed sequence of operation for all equipment or systems.

d. Completed Motor Data Sheet, as specified in Section 16222, for every motor furnished:

1) Submit one copy of the Motor Data Sheet to the ENGINEER for review as part of the associated equipment submittal.

E. Operation and maintenance manuals:

1. As specified in Section 01780.

2. Furnish the ENGINEER with a complete set of written operation and maintenance manuals 8 weeks before energization start-up and/or commissioning.

3. Provide the following additional information in the Electrical and Instrumentation Operation and Maintenance Manuals:

a. Equipment Record or Instrument Data sheet providing complete items supplied, including serial numbers, ranges, options, and other pertinent data necessary for ordering replacement parts.

b. Copy of warranty including procedures in the event of failure.

c. Theory of Operation - Provide description of units and components parts function, normal operating characteristics, and limiting conditions.

d. Operating Instructions that provide complete, detailed, written English description of the sequence of operating sequence for all control system (including PLC) and operations in all mode.

e. Safety Procedures.

f. Troubleshooting instructions.

F. Material and equipment schedules:

1. Furnish a complete schedule and/or matrix of all materials, equipment, apparatus, and luminaries that are proposed for use:

a. Include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.

G. Schedule of values:

1. In addition to completing all items referred to in the Summary of Work, Section 01110, submit per unit material and labor costs used in developing the final bid for the electrical system, for the express purpose of pricing and cost justification for any proposed change orders. In addition to the items shown on the summary of work, provide per unit material and labor costs for conduit and wire installation for specific types, sizes, and locations as indicated on the Drawings and Conduit Schedule. It is the responsibility of

the electrical subcontractor to prove to the ENGINEER's satisfaction that said per unit costs were used in the development of the final Bid amount.

H. Roof penetrations:

1. Submit details of all portions of the electrical installation that penetrate the roof. Include details showing support of the penetrating component, and the sealing means to be utilized.

I. Record Documents:

1. Furnish as specified in Section 01770.

2. Provide Record Documents of all Electrical and Instrumentation Drawings.

3. Record Documents requirements:

a. Record documents shall be used specifically for recording the as built locations and layout of all electrical and instrumentation equipment, routing of raceways, junction and pull boxes, and other diagram or document changes. These Record documents shall not be used for daily construction use and shall not contain any mark-ups that are unrelated to as-built corrections.

b. Update Record Documents weekly. Record documents shall be updated to reflect "change orders", submittal modifications, "field directives", and other construction changes shown and stamped with "As-Built" at end of job.

c. The following lists the record documents that shall be as-built by Contractor:

1) E-Series Drawings

2) Panelboard schedules

3) Conduit and Wire Routing Schedule

4) Lighting Schedule

5) Duct banks and their routing with offset measurement and indicate changes in depth.

6) Show the following on the Electrical (E-Series) Record Contract Drawings by dimension from readily obtained base lines:

a) Exact location, type and function of electrical and instrumentation equipment and devices.

b) Precise routing and locations of underground conduits, duct banks, vaults, pullboxes, junction boxes, and appurtenances that make-up the raceway system.

c) Dimensions, location and routing of electrical work, which will become permanently concealed.

d) Complete routing and sizing of any significant revisions to the systems shown.

d. The following lists the record documents that shall be as-built by System Supplier to be maintained by Contractor:

1) P-Series Drawings

2) Section 17101 Shasta Park Water Facility Specific Control Strategies

3) Section 17903 Schedules – I/O List

4) Section 17901 Schedules – Field Instruments

e. Record Documents must be fully updated as a condition of the monthly progress payments.

f. Submit Record Documents upon completion of the Work for final review.

g. When documents are changed, they shall be marked with erasable colored pencils using the following coloring scheme:

1) Additions – red

2) Deletions – green

3) Comments - blue

4) Dimensions – black

4. Shop drawings:

a. Upon completion of the Work, update all shop drawings to indicate the final as-built configuration of the systems:

1) Provide as-built shop drawings for all electrical equipment on 11-inch by 17-inch using Bond paper.

2) Provide unlocked electronic copies of these documents on CD-ROM disks in AutoCAD format (version 2010 by Autodesk) and PDF format (by Adobe). Size all drawings to be readable and legible on 11-inch by 17-inch media.

b. Furnish written information prepared specifically for this Project using Microsoft Word and printed on 8.5-inch by 11-inch plain bond paper:

1) Provide electronic copies of these documents on CD-ROM disks.

c. Provide one (1) set of record full-size Electrical and Instrumentation series Record Contract Drawings and specifications, neatly marked, accurately showing changes to design.

5. Review and corrections:

a. Correct any record documents or other documents found to be incomplete, not accurate, of poor quality, or containing errors.

b. Promptly correct and re-submit record documents returned for correction.

6. Factory Testing (Performance Testing):

a. As specified in Section 01750 under Performance Testing and Section 17950.

b. As required by specific Electrical Specifications for equipment to be tested.

J. General Start-Up and Testing Procedures, Functional Testing, Certification of Proper Installation, Training of OWNER'S Personnel, and Operational Testing:

1. As specified in Section 01750.

2. As required by specific Electrical Specifications for equipment to be tested.

3. Additional requirements for Field Acceptance Tests as part of the General Start-Up and Testing Procedures are specified in Section 16950 and Section 17950.

K. Calculations:

1. Where required by specific Electrical Specifications:

a. Because these calculations are being provided by a registered professional engineer, they will be reviewed for form, format, and content but will not be reviewed for accuracy and calculation means.

2. Calculations and details are required for all electrical component supports and attachments, unless specifically exempted in Section 01900 or Design Criteria shown on Contract Drawing GS01. Refer to Part 3 below for additional "EQUIPMENT ANCHORING" requirements.

a. The calculations and details shall be in accordance with the requirements of the 2010 CBC and ASCE 7-05, and shall be signed and stamped by a professional engineer registered in the state of California.

b. Refer to Design Criteria shown on Contract Drawing GS01for wind design parameters.

c. Refer to Section 01900 for seismic design parameters.

1.06 QUALITY ASSURANCE

A. The components and equipment covered by these Specifications shall be designed, tested assembled, and installed in accordance with the minimum requirements of the latest published standards of the National Electrical Code (NEC), National Electrical Safety Code (NESC), Underwriters Laboratory (UL), American National Standard Institute (ANSI), Institute of Electrical and Electronic Engineers, Inc. (IEEE) and the National Electrical Manufacturing Association (NEMA).

B. Only NEMA rated contactors are allowed. IEC rated contactors are not allowed.

1.07 DELIVERY, STORAGE, AND PROTECTION

A. Shipping precautions:

1. After completion of shop assembly and successful factory testing, pack all equipment in protective crates, and enclose in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.
2. Place dehumidifiers, when required, inside the polyethylene coverings.
3. Skid-mount the equipment for final transport.
4. Provide lifting rings for moving without removing protective covering.
5. Display boxed weight on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

B. Delivery and inspection:

1. Deliver products in undamaged condition, in manufacturer's original container or packaging with identifying labels intact and legible. Include date of manufacture on label.

C. Special instructions:

1. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.

D. Protection during Construction:

1. Throughout this contract, provide protection for materials and equipment against loss or damage.
2. Prior to installation, follow manufacturer's recommendations for storage. Protect equipment from effects of weather. Store equipment subject to corrosion or containing electrical insulation such as transformers, conductors, motors, controllers, etc., in clean, dry, indoor, heated locations. Heating shall be sufficient to prevent corrosion. Energize all space heaters furnished with equipment.
3. Following installation, protect materials and equipment from corrosion, physical damage and the effects of moisture until placed in service. When equipment intended for indoor installation is installed and subject to dampness, moisture, dirt or other adverse atmosphere as determined by ENGINEER, ensure that adequate protection is provided as acceptable to ENGINEER. Cap conduit runs during construction. Energize all space heaters furnished and keep all equipment heated with means acceptable to ENGINEER until equipment put in service.

1.08 PROJECT OR SITE CONDITIONS

A. Site conditions:

1. Provide an electrical, instrumentation and control system, including all equipment, raceways and any other components required for a complete installation that meets the environmental conditions for the Site as specified in the General Requirements and below and shown on Contract Drawings.

2. Seismic classification:

   a. Provide all electrical equipment and construction techniques suitable for the seismic requirements for the Site, as specified in Section 01900.

3. Wind:

   a. Provide all electrical equipment and construction techniques suitable for the Site wind loading criteria, as specified in the Design Criterial on Contract Drawing GS01.

4. Altitude, temperature and humidity:

   a. As specified in Section 01610.

   b. Provide all electrical components and equipment fully rated for continuous operation at this altitude, with no additional derating factors applied.

   c. Provide for 50° C rated equipment and motors where installed outdoors or within non air-conditioned rooms, unless called out otherwise.

   d. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer's guidelines:

      1) Provide all power conduits wiring for these devices (e.g. heaters, fans, etc.) whether indicated on the Drawings or not.

5. Site security:

   a. Abide by all security and safety rules concerning the Work on the Site, as specified in Section 01500.

6. Outdoor installations:

   a. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.

   b. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in this Section for the equipment:

      1) Provide all wiring necessary to power these devices.

B. Provide enclosures and conduits for electrical, instrumentation and control equipment, regardless of supplier or subcontractor furnishing the equipment, that meet the requirements outlined in NEMA Standard 250 for the following types of enclosures:

1. NEMA Type 1: Intended for indoor use, primarily to provide a degree of protection from accidental contact with energized parts or equipment.
2. NEMA Type 3R: Intended for outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing, or hose directed water, ice formation, and freezing.
3. NEMA Type 4: Intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing, or hose directed water, ice formation, and freezing.
4. NEMA Type 4X: Made from corrosion resistant materials (fiberglass reinforced plastic, 316 stainless steel or equal) and are intended for indoor or outdoor use, primarily to protect equipment from exposure to windblown dust and rain, splashing or hose directed water, ice formation and freezing, and corrosion.
5. NEMA Type 12: Intended for indoor use, primarily to provide a degree of protection from dust, falling dirt and dripping non-corrosive liquids.
6. NEMA Type 6: Rated for submergence.
7. NEMA Type 6P: Rated for prolonged submergence.
8. Provide all Electrical Work in accordance with the following table. Electrical materials shall be per Electrical Classification and Material Table below, unless otherwise specifically indicated on the Drawings or called out for in Specification Section covering that specific equipment. Table does not show electrical materials for concealed areas, refer to Specification 16130. Refer to Specification Section 16130 for further conduit requirements.
9. Provide PVC coated galvanized rigid steel (GRS-PVC) elbows and conduits for transitions from underground or concealed up into equipment.
10. Provide GRS-PVC conduits, conduit bodies, and fittings for all outdoor raceways. Provide galvanized rigid steel (GRS) conduits, conduit bodies, and fittings for all interior exposed raceways unless noted as PCS in following Material Table.

C. Provide enclosures and conduits and support materials as outlined in Material Table below for each listed area. If area is not listed in table it is considered “All Other Areas”. If enclosure or conduit or support material is specifically called out on Contract Drawing, than that material type shall govern over Material Table.

Material Table				
PLANT AREA	NEMA ENCLOSURE TYPE	EXPOSED (NON CONCEALED) CONDUIT TYPE (EXCLUDING STUB-UPS)	ENVIRONMENT W = WET D = DAMP C = CLEAN/DRY X = CORROSIVE H = HAZARDOUS	SUPPORT MATERIALS
Control Bldg. Interior Electrical, Control, Fire Riser, Restroom and Storage Rooms	12	GRS	C	Galvanized Steel
Control Bldg. Interior Chemical Rooms	4X	PVC-80	X	Stainless Steel
10 - Well, Open Areas	4, 4X SST	GRS-PVC	W	Stainless Steel
20 - Methane Treatment System-Exterior	4X SST	GRS-PVC	W	Stainless Steel
31, 32 – Manganese Filter 1 & 2	4X SST	GRS-PVC	W	Stainless Steel
40 – Backwash Tank Area	4X SST	GRS-PVC	W	Stainless Steel
50 – Water Storage Tank Area	4, 4X SST	GRS-PVC	W	Stainless Steel
60 - Treated Water Pump Station	4, 4X SST	GRS-PVC	W	Stainless Steel
96 - Main Elec Bldg Switchgear Room	1, 12	GRS	C	Galvanized Steel
96 - Main Elec Bldg PLC Room	1, 12	GRS	C	Galvanized Steel
96 - Main Elec Bldg Exterior and Rooftop	4	GRS-PVC	W	Galvanized Steel
All Other Areas	4X SST	GRS-PVC	W	Stainless Steel

1.09 SEQUENCING

A. General:

1. General scheduling requirements are specified in Section 01312.
2. Work restrictions and scheduling requirements are specified in Section 01140.
3. General meeting requirements are specified in Section 01310.
4. Testing requirements are specified in Sections 01750, 16950, 17950 and other sections.
5. As specified in Section 01750.

B. Pre-submittal conference:

1. Before producing any submittals, schedule a pre-submittal conference for the purposes of reviewing the entire Project, equipment, control philosophy, schedules, and submittal requirements.

2. The CONTRACTOR, instrumentation and control subcontractor, electrical subcontractor, all suppliers, and individual equipment manufacturers furnishing major pieces of equipment must attend, including but not limited to:

   a. Vendor control panels.

   b. Chemical feed systems.

   c. Networked motor control centers.

   d. Switchboard.

   e. Variable frequency drives.

   f. Lighting.

   g. Engine generators. (Where shown)

3. The PROGRAMMER shall be invited to attend the pre-submittal conference.

C. System configuration meetings:

1. Attend system configurations meetings per Section 17050.

D. Factory Acceptance Tests (FAT) (Performance Testing):

1. Where Factory Acceptance Testing, also referred to as Performance Testing, is required for equipment covered by these Specifications, notify the OWNER and ENGINEER in writing when the equipment is completed and ready for factory inspection and testing:

   a. Indicate the desired dates for inspection and testing. Dates shall be on those agreed to by the City and Engineer.

   b. Schedule the FAT after approval of the FAT procedures and pre-FAT test results submittal:

      1) Submit a copy of the test procedures including all forms at least 21 days before any scheduled test date.

      2) Notify the ENGINEER of the scheduled tests a minimum of 14 days before the date of the test.

      3) Pre-FAT test results shall be submitted for approval at least 10 working days before any scheduled FAT test date. FAT shall be rescheduled until after the submittal has been reviewed by the Engineer and marked “No Exceptions Taken” or “Make Corrections Noted”.

   c. FAT shall be performed as specified in Section 17950.

E. Loop validation test.

1. Notify the ENGINEER of scheduled tests a minimum of 30 days before the estimated completion date of installation and wiring of the PCIS.

2. Complete loop validation testing a minimum of 5 days before the pre-commissioning phase of the project.

3. Loop validation certifications:

   a. After the field device loop tests have been successfully completed as specified in Section 17950 for all individual instruments, all separate analog control networks, all valves, all VCPs, all motors, all local operator interface panels, all motor control centers, etc., submit a certified copy of all test forms signed by the CONTRACTOR, ICSC, and the OWNER's representative with test data entered, together with a clear and unequivocal statement that all instrumentation, including all control and signal wiring, has been successfully calibrated, inspected, and tested.

F. Training:

1. As specified in Section 01750.
2. Complete all training before the pre-commissioning phase of the project may start.
3. Schedule the training sessions a minimum of 21 days before the start date of the courses.
4. Submit training manuals to the ENGINEER a minimum of 10 days before starting the training session.
5. Within 10 days after the completion of each session, submit the following:

   a. A list of all OWNER personnel that attended the session.

   b. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.

G. Pre-commissioning test:

1. Commence after acceptance of all training, wire test, calibration tests, and loop validation tests, and all inspections have demonstrated that the PCIS complies with all Contract requirements.
2. Acceptance of the PCIS pre-commissioning testing must be provided in writing by the ENGINEER before the performance testing may begin.
3. The PROGRAMMER shall assist with pre-commissioning testing for PLCs programmed by the PROGRAMMER, as specified in Section 17950.
4. The PROGRAMMER shall not be required to be on site, nor shall the PROGRAMMER be required to supply application software, until the loop validation tests are complete for a PLC and all prerequisites for the pre-commissioning test are completed.

H. Provide all special tools and spare parts, as specified in the Maintenance paragraph of this Section, before performance testing commences, suitably wrapped and identified.

I. General Start-Up and Testing Procedures:

1. Refer to Section 16950.
2. Electrical field acceptance testing as part of the General Start-Up and Testing Procedures must be completed prior to Functional Testing of equipment.

J. Performance testing:

1. Complete pre-commissioning test a minimum of 5 days before the performance test.

K. Substantial completion: The following conditions be fulfilled before the PCIS is considered complete:

1. All submittals have been completed and approved.
2. The PCIS has been calibrated, loop tested and pre-commissioned.
3. The OWNER training has been performed.
4. All required spare parts, expendable supplies, and test equipment have been delivered to the OWNER.
5. The performance test has been successfully completed.
6. All debris associated with installation of instrumentation has been removed.
7. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.10 WARRANTY

A. Warrant the Electrical Work as specified in Section 01781.

1. Provide additional warranty as specified in the individual Electrical Specifications.

B. The Contractor shall warrant all electrical and instrumentation equipment and software programming supplied under Division 16 & 17 for a period of one (1) year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer or supplier.

C. The Contractor shall provide all labor and material to troubleshoot, replace, or repair any hardware or software that fails or operates improperly during the warranty period, at no additional cost to the Owner.

D. This warranty shall cover all parts, travel costs, and labor. The system supplier shall have a staff of experienced personnel available to provide service on a 2 working days notice during the warranty period.

E. If the system supplier "fails to respond" in 2 working days, the City at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the Contractor. "Fail to respond" shall be defined as: The Contractor has not shown a good faith effort and has not expended adequate resources to correct the problem. The use of other resources, as stated above, shall not change or relieve the Contractor or supplier from fulfilling the remainder of the warranty requirements.

F. Each time the Supplier's repair person responds to a system malfunction during the warranty period, he or she must contact the City for scheduling of the work, access to the jobsite, and permission to make repairs. The supplier shall contact the City at 808-5226 and ask for the electrical supervisor. Operation of facilities necessary to test equipment shall only be performed by or under the direction of City staff. The City reserves the right at its sole discretion to deny operations

requested by the Supplier. A written description of all warranty work performed shall be documented on a field service report to be given to Owner prior to the repair person leaving job site each day. This field service report shall detail and clearly state problem, corrective actions taken, additional work that needs to be done, data, repair person name and company.

G. Prior to "final acceptance", the Contractor shall furnish to the Engineer a listing of the warranty information for all manufacturers of materials, instruments, and equipment used on the project. The listing shall include the following:

1. Manufacturer's name, service contact person, phone number, and address.
2. Material and equipment description, equipment number, part number, serial number, and model number.
3. Manufacturer’s warranty expiration date.

1.11 FUNCTIONAL TESTING RESULTS

A. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:

1. Following replacement or modification, retest the system; starting with General Start-Up and Testing Procedures, and then perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the ENGINEER.

1.12 MAINTENANCE

A. Before Substantial Completion Operational Testing, perform all maintenance activities required by any sections of the Specifications including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.

B. Furnish all spare parts as required by other sections of the Specifications.

1.13 ELECTRICAL CONTRACTOR QUALIFICATIONS

A. It is the intent of this Division that the complete responsibility for management and installation of the electrical and instrumentation required for this project be by a qualified Electrical Contractor. This responsibility includes, but not limited to, supervision and coordination of work performed by all suppliers of Division 16.

B. Uncertified electricians shall not perform electrical work for which certification is required per Labor Code Section 3099. Electricians shall be required to carry proof of certification on their person at all times. Electricians found on the jobsite without proof of certification will be asked to leave, prohibited from working on-site until proof of certification has been provided and may be reported to the Contractors State License Board (CSLB).

C. Contractor shall submit the proposed Electrical Subcontractor and System Supplier with bid documents that will be used on this project.

D. If the Contractor, Electrical Subcontractor, and System Supplier listed in bid documents are deemed not qualified by Owner, they will have their bid rejected at the Owner’s sole discretion and the next qualified bidder selected.

E. The Electrical Subcontractor shall meet the following minimum qualifications:

1. Has a current C-10 Electrical Subcontractor's License.
2. Has regularly engaged in similar electrical contracting for the Municipal Water and Wastewater Industry.
3. Has successfully performed work of similar or greater complexity on at least two previous projects under one company name and under the present company name.
4. Has all persons performing work as electricians certified by the California Apprenticeship Council per California Labor Code Section 3099.
5. Has been actively engaged in the type of electrical and instrumentation work specified in this Division for a minimum of two years.

F. Bid package shall include a list of five (5) completed projects of similar size and nature for water or wastewater treatment plants the Electrical Contractor has completed:

1. Provide completion dates of projects.
2. References of Owner Representative in charge of project, including contact name and telephone number.

1.14 SYSTEM SUPPLIER QUALIFICATIONS

A. General:

1. It is the intent of this Division that complete responsibility in the supplying of the MCC/PLC, and all instrumentation in Appendix "B" Device Index and other equipment required for this project be supplied by one System Supplier. This responsibility includes, but not limited to, all work necessary to select, furnish, program, supervise installation, calibrate, and place into operation all transmitters, instruments, controllers, alarm equipment, monitoring equipment, and accessories as specified herein.
2. The system supplier shall have an on staff project engineer with prior experience on similar sized projects. This project engineer shall coordinate the technical aspects of this project and prepare the submittals and drawings. The system supplier project engineer shall attend all coordination meetings and be on-site when requested by the Owner's Engineer.
3. The list of approved Control Systems Integrators who are considered by the City as qualified to program the local PLC and SCADA system is listed in Section 17100.

B. Pre-Qualified System Suppliers

1. The Suppliers listed below have been determined to meet minimum qualifications specified in this Division and are pre-qualified by the Owner for providing supplier bids as system suppliers on the project.
   a. Tesco (phone 916 395-8800).
   b. Krug-Bixby-Long (KBL) (phone 510 887-1117).

c. MCC Control Systems (formerly Meyer Controls) (phone 707 449-0341).

C. Non-Pre-Qualified System Suppliers

1. System Suppliers not pre-qualified by the Owner shall submit the information listed herein at least 14 calendar days prior to bid date, and if approved by the Owner, will be listed in a Contract addendum prior to bid.

   a. Company history.

   b. List of five (5) completed projects of similar size and nature for water treatment plants.

   c. Provide completion dates of projects.

   d. References of Owner Representative in charge of project, including contact name and telephone number.

   e. List of projects in progress.

   f. Description of scope of projects.

   g. Dollar amount of projects.

   h. References of Owner Representative in charge of project, including contact name and telephone number.

   i. Complete 2014 Year End Financial statement prepared by a Certified Accountant or complete 2014 Company Tax Returns listing assets and liabilities.

2. Factory test for this project shall be held within 150 miles of project location at the System Suppliers shop.

3. Additional information for clarification as requested by the Owner in writing shall be provided by the System Supplier asking for the qualification or qualification will automatically be denied.

4. System Supplier providing financial statements lacking detail or stating that detailed financial records are proprietary will be disqualified as a qualified System Supplier and is grounds alone for disqualification.

5. Any qualification package deemed incomplete or lacking sufficient information to determine qualification will result in System Supplier not being qualified.

6. No reason will be released on why a System Supplier was not qualified.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide similar items of same manufacturer throughout the electrical and instrumentation portion of the Project.

B. Allowable manufacturers are specified in individual Electrical Specifications.

2.02 EXISTING PRODUCTS

A. Existing Hirsch Security System:

1. Refer to Section 16752.
2. Verify existing Hirsch security system prior to submittal of equipment.

2.03 MATERIALS

A. Furnish all materials under this Contract that are new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products and that bear all approvals and labels as required by the Specifications.

B. Provide materials complying with the applicable industrial standard as specified in Section 01600.

C. Stainless steel:

1. Where stainless steel is indicated or used for any portion of the Electrical Work, provide a non-magnetic, corrosion-resistant alloy, ANSI Type 316, satin finish.
2. Provide exposed screws of the same alloys.
3. Provide finished material free of any burrs or sharp edges.
4. Use only stainless steel hardware, when chemically compatible, in all areas that are or could be in contact with corrosive chemicals.
5. Use stainless steel hardware, when chemically compatible, in all chemical areas or areas requiring NEMA Type 4X construction.
6. Do not use stainless steel in any area containing chlorine, gas or solution, chlorine products or ferric chloride.

D. Switchboard Rubber Matting:

1. Furnish and install high voltage rubber matting in front of the following equipment:
   a. Motor Control Center
   b. Switchboards
   c. PLC Panels
   d. Other equipment located inside electrical room
2. Matting shall be black, ¼” thick, 48” wide and running full length of equipment plus 12” on both sides.
3. Matting shall conform to ASTM D178-93 Type 1 Class 2, proof tested at 20,000 volts AC.
4. Manufacturers or equal:
   a. Warco Biltrite ASTM Switchboard Type 1 Rubber Matting.

2.04 SOURCE QUALITY CONTROL

A. Provide all equipment that is new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products.

B. Arrange with all manufacturers of the electrical equipment, to allow the OWNER and ENGINEER to inspect and witness the testing of the equipment at the site of fabrication:

1. Testing includes the cabinets, special control systems, power equipment, and other pertinent systems and devices.

C. Factory testing is specified in the individual sections of the Electrical Specifications.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The electrical subcontractor is encouraged to attend a pre-bid conference and examine the premises completely before bidding. It is the electrical subcontractor's responsibility to be fully familiar with the existing conditions and local requirements and regulations.

B. During construction, the CONTRACTOR shall review the site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.

C. CONTRACTOR shall provide a complete electrical system:

1. Install all extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical, PCIS, and HVAC system.

3.02 INSTALLATION

A. Equipment locations shown on Electrical Drawings may change due to variations in equipment size or minor changes made by others during construction:

1. Verify all dimensions:

a. Actual field conditions govern all final installed locations, distances, and levels.

2. Coordinate Work as necessary to adjust due to changes.

3. Make minor changes in location of equipment before rough in, as required and approved by the OWNER or ENGINEER.

4. All equipment shall be installed and located so that it can be readily accessed for operation and maintenance. The Engineer reserves the right to require minor changes in location of equipment, without incurring any additional costs. These minor changes are changes which would provide adequate clearance and work areas in front of and around equipment.

B. Install all material and equipment in accordance with the manufacturer’s installation instructions, including anchoring methods and leveling criteria:

1. Where CONTRACTOR asks to deviate from the manufacturer’s recommendations, such changes shall be reviewed and accepted by the ENGINEER and manufacturer before installation.

2. Keep a copy of the manufacturer's installation instructions on the jobsite available for review at all times prior to and during the installation of the associated equipment.

C. Cutting and patching:

1. Perform all cutting, patching, channeling, core drilling, and fitting required for the Electrical Work, except as otherwise directed:

   a. Secure the permission of the ENGINEER before performing any operation likely to affect the strength of a structural member such as drilling, cutting or piercing:

      1) Before cutting, channeling, or core drilling any surface, ensure that no penetration of any other systems will be made:

         a) Verify that area is clear and free of conduits, cables, piping, ductwork, post-tensioning cables, etc.

         b) Use tone-locate system or X-ray to ensure that area is clear of obstructions.

   b. Review the complete Drawing set to ensure that there are no conflicts or coordination problems before cutting, channeling, or core drilling any surface.

2. Perform all patching to the same quality and appearance as the original work. Employ the proper tradesmen to secure the desired results. Seal around all conduits, wires, and cables penetrating walls, ceilings, and floors in all locations with a fire stop material, typically:

   a. 3M CP 25WB+ Caulk.

   b. 3M Fire Barrier Putty.

3. Seal around conduit penetrations of below grade walls with a waterproof, non-shrink, non-metallic grout, unless otherwise indicated on the typical installation details:

   a. Use the installation details indicated on the Drawings as a guide for acceptable sealing methods.

4. Install all conduits and equipment in such a manner as to avoid all obstructions and to preserve headroom and keep openings and passageways clear:

5. Install all conduits and equipment in accordance with working space requirements as outlined in the NEC.

   a. This includes any panel, disconnect switch or other equipment that can be energized while open exposing live parts regardless of whether is likely to require examination or has serviceable parts.

6. Where the Drawings do not show dimensions for locating equipment, install equipment in the approximate locations indicated on the Drawings.

   a. Adjust equipment locations as necessary to avoid any obstruction or interferences.

7. Where an obstruction interferes with equipment operation or safe access, relocate the equipment.

8. Where the Drawings do not indicate the exact mounting and/or supporting method to be used, use materials and methods similar to the mounting details indicated on the Drawings.

D. Earthwork and concrete:

1. Install all trenching, shoring, concrete, backfilling, grading and resurfacing associated with the Electrical Work:

a. Requirements as specified in the Contract Documents.

E. Roof penetrations:

1. Seal conduit penetrations in accordance with roofing manufacturer's instructions.

F. Terminations:

1. Provide and terminate all conductors required to interconnect power, controls, communication, instruments, panels, and all other equipment.

G. Miscellaneous installation requirements:

1. In case of interference between electrical equipment indicated on the Drawings and the other equipment, notify the ENGINEER as specified in Section 01105.

2. Location of manholes and pullboxes indicated on the Drawings are approximate. Coordinate exact location of manholes and pullboxes with Mechanical and Civil Work.

3. Provide additional manholes or pullboxes to those shown where they are required to make a workable installation.

H. Labeling:

1. Provide all nameplates and labels as specified in Sections 16075 and Section 16305.

I. Equipment tie-downs:

1. Anchor all instruments, control panels, and equipment by methods that comply with seismic and wind bracing criteria, which apply to the Site.

2. All electrical equipment and panels must be permanently mounted and tied down to structures in accordance with the Project seismic criteria.

3.03 EQUIPMENT ANCHORING

A. Floor-supported, wall, or ceiling-hung equipment, components, and conductors shall be anchored in place by methods that will meet seismic requirements in the area where the Project is located.

B. Provide wall-mounted panels that weigh more than 500 pounds or that are within 18 inches of the floor with fabricated steel support pedestals.

C. If the supported equipment is a panel or cabinet enclosed within removable side plates, match supported equipment in physical appearance and dimensions.

D. Provide transformers hung from 4-inch stud walls and weighing more than 300 pounds with auxiliary floor supports.

E. Provide leveling channels anchored to the concrete pad for switchgear and pad-mounted transformer installations.

F. Manufacturer's Recommendations

1. Anchoring methods and leveling criteria in the printed recommendations of the equipment manufacturers are a part of the WORK of this Contract.

2. Submit such recommendations as Shop Drawings as indicated.

G. Anchors: Anchor bolts shall be in accordance with Section 05120 – Structural Steel.

1. Anchor bolt calculations shall clearly show that the capacity of the anchor and the capacity of the concrete that the anchor is embedded in are adequate to resist all applicable load combinations, including wind and seismic.

2. Reduction factors associated with edge distance, embed length, and bolt spacing shall all be considered and based on the actual dimensions of the concrete that resists the anchorage forces.

3. Anchor bolt details shall include required bolt diameter, embed, and edge distances.

4. The design of anchors shall satisfy the ductility requirements stated in ASCE 7-05, Chapter 13, Section 13.4.2.

5. Equipment pads shall be constructed with anchor bolt edge distances not less than those required by the anchorage calculations.

3.04 FIELD QUALITY CONTROL

A. Inspection:

1. Allow for inspection of electrical system installation as specified in Section 01410.

2. Provide any assistance necessary to support inspection activities.

3. ENGINEER inspections may include, but are not limited to, the following:

a. Inspect equipment and materials for physical damage.

b. Inspect installation for compliance with the Drawings and Specifications.

c. Inspect installation for obstructions and adequate clearances around equipment.

d. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.

e. Inspect equipment nameplate data to verify compliance with design requirements.

f. Inspect raceway installation for quality workmanship and adequate support.

g. Inspect cable terminations.

4. Inspection activities conducted during construction do not satisfy inspection or testing requirements specified in Section 16950.

5. A set of as built single-line and wiring drawings shall be shipped with all enclosures (i.e. Switchboard, MCC, Control Panels, etc.) and provided within the enclosure, secured in a fabricated metal or plastic drawing sleeve. Final as-built drawings shall be updated after equipment has been brought “on-line” and all required field changes have been electronically incorporated into drawings. As-built drawings which reflect enclosure status as shipped from the factory are not acceptable. Contractor shall also place the final set of as-built drawings in the O&M manuals.

B. Field testing is specified in Section 17950. Additional general requirements are specified in Section 01750.

C. General Start-Up and Testing Procedures:

1. Notify the ENGINEER when the Electrical Work is ready for field testing as part of the General Start-Up and Testing Procedures.

2. Perform the field tests as specified in Section 16950 and in specific sections.

D. Functional Testing:

1. Perform the Functional Testing as specified in Section 01750 and per approved CONTRACTOR’S Start-Up Plan.

E. Workmanship:

1. The Contractor shall employ personnel that are skilled and experienced in the installation and connection of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

2. All cutting and notching shall be laid out carefully in advance. Do not notch any structural member or building surface without specific approval from the Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to new condition using skilled craftsmen of the trades involved. Refinish damaged surfaces to new condition using skilled craftsmen of the trades involved at no additional cost to the Owner.

3. Keep the premises free from accumulation of waste material or rubbish on a daily basis. Upon daily completion of work, remove materials, scraps, and debris from the premises and from the interior and exterior of all devices and equipment.

4. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:

a. Neatly coil and label spare wiring lengths.

b. Shorten, re-terminate, and re-label excessive used as well as spare wire and cable lengths, as determined by the ENGINEER.

3.05 CLEANING

A. As specified in Section 01770.

B. Remove all foreign material and restore all damaged finishes to the satisfaction of the ENGINEER and OWNER.

C. Prior to startup and at the completion of the work prior to final acceptance clean and vacuum all enclosures, equipment, exposed conduit, devices and fittings to remove all metal filings, surplus insulation and any visible dirt, dust or other matter before energization of the equipment or system start-up:

1. Use of compressors or air blowers for cleaning is not acceptable.

2. Wipe down exterior of all enclosures.

3. Remove all grease and metal cuttings.

4. Any discoloration or other damage to parts of the building, the finish, or the furnishings, shall be repaired.

5. Thoroughly clean any of his exposed work requiring same.

6. Vacuum and clean the inside of all MCCs, field control stations, electrical panels and electrical and instrumentation enclosures.

7. Clean all above and below ground pull boxes, junction boxes, and vaults from all foreign debris prior to final acceptance.

8. Special “Soft–Jaw” type pipe clamps shall be used to prevent damage to PVC-coated conduit while field threading and cutting to length.

9. Paint all scratched or blemished surfaces with the necessary coats of quick drying paint to match adjacent color, texture, and thickness. This shall include all prime painted electrical equipment, including enclosures, panels, poles, boxes, devices.

10. Remove all decals and lettering from both sides of support plates.

11. Repair damage to factory finishes with repair products recommended by Manufacturer.

12. Repair damage to PVC or paint finishes with matching touchup coating recommended by Manufacturer.

D. Clean and re-lamp all new and existing luminaires that were used in the areas affected by the construction, and return all used lamps to the OWNER.

E. As specified in other sections of the Contract Documents.

3.06 DEMONSTRATION AND TRAINING

A. Furnish all personnel and equipment necessary to conduct the demonstration and training requirements as specified in the individual sections.

B. Refer to Section 01750 for training requirements.

3.07 PROTECTION

A. Protect all Work from damage or degradation until Substantial Completion.

B. Maintain all surfaces to be painted in a clean and smooth condition.

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Grounding electrodes.
2. Grounding electrode conductors.
3. Equipment grounding conductors.
4. Main bonding jumper.
5. Ground connections.
6. General requirements for grounding.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 16050 - Common Work Results for Electrical.
   c. Section 16123 - 600 Volt or Less Wires and Cables.
   d. Section 16950 - Field Electrical Acceptance Tests.

1.02 REFERENCES

A. As specified in Section 16050.

B. ASTM International (ASTM):

1. B 3 - Standard Specification for Soft or Annealed Copper Wire.
2. B 8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Ground equipment and raceway systems so that the completed installation conforms to all applicable code requirements. All components of the grounding electrode system shall conform to the applicable requirements of National Electrical Code Article 250 and local codes.

B. Provide a complete electrical grounding system as indicated on the Drawings and as specified including but not limited to:

1. Grounding electrode conductors.

2. Ground ring.

3. Bonding jumpers.

4. Ground connections.

5. Ground rod boxes.

C. Provide bonding jumpers and wire, grounding bushings, clamps and appurtenances required for complete grounding system to bond equipment and raceways to equipment grounding conductors. There shall be an equipment grounding conductor in each raceway.

D. The ground system resistance (electrode to ground) of the completed installation, as determined by tests specified in Section 16950, shall be:

1. 5 ohms or less.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Catalog cut sheets for connections, clamps, and grounding system components.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. All grounding components and materials shall be UL listed and labeled.

C. All components of the grounding electrode system shall be manufactured in accordance with ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 WARRANTY

A. As specified in Section 16050.

1.09 SYSTEM START-UP

A. As specified in Section 16050.

B. All grounding shall be installed, tested and approved prior to energizing connected equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Compression connectors: One of the following or equal:

1. FCI Burndy.
2. Thomas & Betts.

B. Ground rods: One of the following or equal:

1. Erico.
2. Harger.
3. Conex.

C. Grounding electrode conductor and ground ring: One of the following or equal:

1. Nehring.
2. Harger.
3. Southwire.

D. Precast ground well boxes and lids: One of the following or equal:

1. Christy Concrete Products, G03 Valve Box with cast iron lid, F08 Valve Box with concrete lid.
2. Brooks Products, 3-RT Valve Box.

2.02 MATERIALS

A. Ground rod:

1. Minimum: 3/4-inch diameter, 10 feet long.
2. Uniform 10 mil covering of electrolytic copper metallically bonded to a rigid steel core:
   a. The copper-to-steel bond shall be corrosion resistant.
3. In accordance with UL 467.
4. Sectional type joined by threaded copper alloy couplings.
5. Fit the top of the rod with a threaded coupling and steel-driving stud.

B. Grounding electrode conductor and ground ring:

1. Requirements:
   a. Soft drawn (annealed).
   b. Concentric lay, coarse stranded in accordance with ASTM B 8.
   c. Bare copper in accordance with ASTM B 3, suitable for direct buried.

2. Grounding electrode conductors shall be as indicated on Drawings with minimum size in accordance with the NEC

3. Ground ring shall be #4/0, unless indicated otherwise on the Drawings, with minimum size in accordance with the NEC.

C. Compression connectors:

1. Manufactured of high copper alloy specifically for the particular grounding application.

2. Suitable for direct burial in earth and concrete.

3. Identifying compression die number inscription to be impressed on compression fitting.

D. Equipment grounding conductors:

1. Conductors shall be the same type and insulation as the load circuit conductors, refer to Specification 16123:

a. Use 600-volt insulation for the equipment grounding conductors for medium voltage systems.

2. Equipment grounding conductors shall be as indicated on Drawings with minimum size in accordance with the NEC.

E. Main bonding jumpers and bonding jumpers:

1. Minimum size in accordance with the NEC.

2.03 ACCESSORIES

A. Precast ground well boxes and lids:

1. Minimum 9 inch interior diameter.

2. Covers in sidewalks or pedestrian areas shall be reinforced concrete or as shown on Drawings. Covers in traffic areas shall be cast iron.

3. Permanent “GROUND” marking on cover.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Provide a separate, green insulated, grounding conductor in each and every raceway independent of raceway material and content:

1. Multi-conductor power and control cables shall include an integral green insulated grounding conductor.

2. Provide a separate grounding conductor in each individual raceway for parallel feeders.

C. Provide a separate grounding conductor for each motor and connect at motor terminal box. Do not use bolts securing motor box to frame or cover for grounding connectors:

1. When grounding motors driven by variable frequency drives (VFD) comply with the requirements of the VFD manufacturer.

D. Provide an insulated throat grounding type bushing with lug for connection of grounding conductor for conduits that originate from each motor control center section, switchboard, or panelboard:

1. Individually bond these raceways to the ground bus in the equipment with green colored insulated copper conductor. Bonding conductor shall be per NEC, or #10 AWG minimum.

E. Provide insulated throat grounding type bushings with lugs for connection of grounding conductor at both ends of metallic conduit runs. Bond ground bushings to the grounding system.

F. Provide a green insulated wire-grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

G. Interconnect the secondary switchgear, switchboard, or panelboard neutral bus to the ground bus in the secondary switchgear, switchboard, or panelboard compartment, only at service entrance point or after a transformer.

H. Copper bonding jumpers shall be used to obtain a continuous metallic ground for equipment such as expansion joints, and cable trays.

I. Duct bank ground system:

1. Provide a bare copper grounding conductor the entire length of each duct bank, embedded in the concrete of the duct bank as indicated on the Drawings and specified in the Specifications.

2. Bond duct bank ground conductors together where duct banks join, merge, intersect, or split.

3. In manholes ground all exposed noncurrent-carrying metallic parts, and ground conductor(s) in duct banks to a ground rod installed in the base of each manhole and handhole with No. 4/0 AWG bare copper wire. Connect No. 2 AWG ground wire to each exposed cable rack by drilling and tapping a hole in each rack, and connecting the ground wire to the racks utilizing tin-plated copper alloy split bolt connectors manufactured by Blackburn, or equal.

J. Grounding at service (600 V or Less):

1. Connect the neutral to ground only at one point within the enclosure of the first disconnecting means on the load side of the service transformer.

K. Ground connections:

1. All connections to the ground grid system, the duct bank grounding system, equipment, ground rods, etc., shall be made using compression type grounding connectors as indicated on the Drawings, UL listed, and labeled for the application.

2. Make ground connections in accordance with the manufacturer's instructions.

3. Do not conceal or cover any ground connections until the ENGINEER or authorized representative has established and provided written confirmation that every grounding connection is as indicated on the Drawings and specified in the Specifications.

L. Grounding electrode system:

1. Ground ring:

a. Provide all trenching and materials necessary to install the ground ring as indicated on the Drawings.

b. Ground ring conductor shall be in direct contact with the earth, or where embedded, concrete, of the size as indicated on the Drawings.

c. Minimum burial depth 36 inches or as indicated on the Drawings.

d. Re-compact disturbed soils to original density in 6-inch lifts.

2. Ground rods:

a. Locations as indicated on the Drawings or as required by field.

b. Provide correct type of ground rod box based on installed location. All boxes and lids installed in areas subject to traffic shall be traffic rated and cast iron lids. All boxes in non-paved areas and concrete walkways shall have concrete lids.

c. In ground rod boxes, install ground rods with ends 6 inches above a sand backfill with compression connections of grounding conductors fully visible and accessible. Provide 18” of sand per Detail.

d. Length of rods forming an individual ground array shall be equal in length.

e. Drive ground rods and install grounding conductors before construction of concrete slabs and duct banks.

f. In manholes install ground rods with ends 4 to 6 inches above the floor with connections of grounding conductors fully visible and accessible.

g. Pre-crimp all ground rods, as recommended by the manufacturer, before crimping connector to ground rod.

3. Metal underground water pipe:

a. Bond metal underground domestic water pipe to grounding electrode system. Connect to largest diameter water pipe available.

4. Metal frame of building or structure:

5. Bond metal frame of building or structure to grounding electrode system.

6. Extend grounding conductors through concrete to accessible points for grounding equipment and electrical enclosures.

7. Install grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.

8. Provide insulated throat grounding bushings for all grounding connections to steel conduits stubbed up within equipment. Provide solid bare copper wire, tying all insulated throat grounding bushings together back to ground grid.

M. Bond all telephone protector units to the system ground network with a No. 6 AWG bare copper ground wire, or larger if shown on Drawings.

N. Instrumentation cable shield grounding:

1. Shielded instrumentation cable shall have its shield grounded at one end only unless shop drawings indicate otherwise:

a. The grounding point shall be at the control panel or at the power source end of the signal carried by the cable.

2. Terminate the shield drain wire on a dedicated terminal block.

3. Use manufacturer's terminal block jumpers to interconnect ground terminals.

4. Connection to the panel main ground bus shall be via a green No. 12 conductor to the main ground bus for the panel.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Refer to Section 16950 for ground system testing requirements to be performed as part of the General Start-Up and Testing Procedures phase. Refer to Section 01750.

3.03 ADJUSTING

A. Under the direction of the ENGINEER, add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurement meets the specified resistance requirements:

1. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

3.04 PROTECTION

A. As specified in Section 16050.

END OF SECTION

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SECTION 16070

HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mounting and supporting electrical equipment and components.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 01410 - Quality Control.

c. Section 05501 - Anchor bolts.

d. Section 09910 - Painting.

e. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. As specified in Section 16050.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Design requirements:

1. Conform to the requirements of the Building Code as specified in Section 01410.

2. Demonstrate the following using generally accepted engineering methods:

a. That the anchors to the structure are adequate to resist the loads generated in accordance with the Building Code and equipment requirements.

b. That the required load capacity of the anchors can be fully developed in the structural materials to which they are attached.

c. That the concrete pad utilized to support and anchor equipment is adequately sized to allow for required concrete from anchor to edge of pad. Distance shall be based on approved structural calculations.

3. Design loading and anchoring requirements:

a. As indicated in the Building Code unless otherwise specified.

b. Seismic loading requirements:

1) Freestanding or wall-hung equipment shall be anchored in place by methods that will satisfy the requirements for the seismic design specified in Section 16050.

c. Wind loading requirements:

1) All exterior freestanding equipment shall be anchored in place by methods that will satisfy the requirements for wind design specified in Section 16050.

d. Minimum safety factor against overturning: 1.5.

e. The foundation and structures to which hangers and supports are attached shall be capable of withstanding all anchor loads.

B. Performance requirements:

1. Hangers and supports individually and as a system shall resist all weights and code-required forces without deflections and deformations that would damage the supporting elements, the equipment supported, or the surrounding construction.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Supports:

a. Materials.

b. Geometry.

c. Manufacturer.

2. Hardware:

a. Materials.

b. Manufacturer.

C. Shop drawings:

1. Complete dimensioned and scalable shop drawings of all supporting structures, trapezes, wall supports, etc.

2. Complete anchoring details, including supporting calculations, for equipment, lighting and raceway, supporting structures, trapezes, wall

supports for all equipment in excess of 200 pounds, and all freestanding supports:

a. Calculations and anchoring details shall be stamped by a professional structural engineer licensed in California.

b. Said submittals, by virtue of the fact that they bear the stamp of a registered engineer, will be reviewed for general consistency with the requirements specified in the Contract Documents, but not for context, accuracy, or method of calculation.

3. Include data on attachment hardware and construction installation methods that will satisfy the design loading and anchoring criteria.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 WARRANTY

A. As specified in Section 16050.

1.10 SYSTEM STARTUP

A. As specified in Section 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Thomas & Betts.
2. Power-Strut.
3. Unistrut.
4. Cooper B-Line.
5. Robroy.
6. Aickinstrut.

2.02 MATERIALS

A. Use materials appropriate for the area as specified in Section 16050.

B. Hot dip galvanized steel:

1. Supports:

a. In accordance with ASTM A 123 or A 153.

b. Minimum zinc coating thickness of 2.6 mils.

2. Hardware:

a. Electro-galvanized.

b. In accordance with ASTM A 153.

C. Stainless steel:

1. Supports:

a. In accordance with ASTM A 240.

b. ANSI Type 316 material.

2. Hardware:

a. ANSI Type 316 material.

D. PVC coated galvanized steel:

1. Supports:

a. Hot dip galvanized steel as specified in this Section.

b. PVC coating thickness of 10 to 20 mils.

2. Hardware:

a. ANSI Type 316 material.

E. Fiberglass:

1. Supports:

a. Vinyl ester.

2. Hardware:

a. Polypropylene.

b. Thermal plastic elastomer.

c. Fiberglass reinforced plastic.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Mount all raceways, cabinets, boxes, fixtures, instruments, and devices on CONTRACTOR fabricated racks as required.

1. Provide the necessary sway bracing to keep trapeze type structures from swaying.

C. Brace and anchor freestanding equipment supports using methods that provide structural support based on the seismic loads and wind loads:

1. Lateral deflection at top of supports not to exceed support height divided by 240 unless otherwise approved by the ENGINEER.

D. Provide fabricated steel support pedestals for wall mounted panels that weigh more than 200 pounds:

1. Fabricate pedestals out of welded angle, tube sections, or preformed channel.

2. If the supported equipment is a panel or cabinet, match the supported equipment in physical appearance and dimensions.

3. Provide auxiliary floor supports for transformers hung from stud walls and weighing more than 200 pounds.

4. Mount all equipment, cabinets, boxes, instruments, and devices in damp or wet locations on minimum of 7/8-inch preformed mounting channel.

a. Mount channel vertically along the length of the device so that water or moisture may run freely behind the device.

E. Corrosion protection:

1. Isolate dissimilar metals, except where required for electrical continuity.

a. Use neoprene washers, 9-mil polyethylene tape, or gaskets for isolation.

F. Raceway:

1. Furnish all conduit racks and trapeze structures needed to support the raceway from the structure.

a. Group conduits and position on racks to minimize crossovers.

b. Provide the necessary bracing to keep trapeze type structures from swaying under loads from cable installation, seismic forces, or wind forces.

G. Anchoring methods:

1. Solid concrete: Anchor bolts, anchor rods or post-installed anchors as specified in Section 05501.

2. Metal surfaces: Machine screws or bolts.

3. Hollow masonry units: Post-installed anchors as specified in Section 05501.

H. When supporting devices on metal or wood stud construction, bridge studs with preformed channel, and mount the devices to the channel.

I. Re-coat all scratches, cuts, and drilled holes in galvanized surfaces with CRC "Zinc-It" or similar product.

J. Re-coat all drilled holes and cut surfaces on PVC coated materials.

K. Seal all drilled holes and cut surfaces on fiberglass materials.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

3.03 PROTECTION

A. As specified in Section 16050.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Identifying electrical, instrumentation, and process equipment and components.

2. Material, manufacturing and installation requirements for identification devices.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

c. All Sections listing equipment, instruments, packaged systems, panels, conduit or cable.

1.02 REFERENCES

A. As specified in Section 16050.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Nameplates:

1. Provide a nameplate for each piece of electrically connected equipment including but not limited to:, instruments, motors, valves, HVAC equipment, switches, receptacles, controllers, transducers, transformers, solenoids, motor control centers, starters, panelboards, switchboards, manholes, handholes, conduits, cables, wires, control devices, disconnect switches, lighting controls, internal and external panel mounted devices, and all vendor supplied equipment that is connected electrically.

2. Provide all nameplates of identical style, color, and material throughout the facility.

3. Device nameplates information:

   a. Designations as indicated on the Drawings.

   b. Device tag number ID (19DSFIT125).

   c. Panelboard and Circuit ID (71LP-1 (12)).

4. Major Equipment:

   a. Manufacturer's nameplate showing the Contract specified name and number designation, the manufacturer's name, model designation, part number, serial number, and pertinent ratings such as voltage, amperage, # of phases, range, calibration, etc.

5. Devices:

   a. Pushbutton, indicator, field control station, disconnect switches, etc.) shall have mounted on the exterior or dead front of a piece of equipment, a nameplate with the “Equipment Name and Equipment Number” inscription as shown in the Contract Documents. Where no inscription is indicated in the Contract Documents, furnish nameplates with an appropriate inscription providing the name and number of device.

   b. All disconnect switches shall have nameplates with ½” high letters and be engraved with designations as shown on one-line drawings or as directed by Owner.

   c. All transformers and panelboards shall have nameplates with ½" high letters and be engraved with designations as shown on one-line Drawings.

6. Field Instruments

   a. Provide nameplate engraved with designation shown on P&ID diagrams.

B. Conduit Numbers:

1. CONTRACTOR shall provide conduit numbers for all conduits, even if not provided on Conduit Schedule. Follow format on Conduit Schedule.

2. Submit conduit tagging scheme for approval. Conduit tag list shall be submitted in electronic spreadsheet format.

3. Provide conduit number (and associated tag) on all conduits unless both ends of exposed conduit are visible from same vantage point and less than 20 feet long. All concealed and underground conduits shall be assigned a number and have a tag on both ends.

C. Wire Numbers:

1. Coordinate the wire numbering system with all vendors of equipment so that every field wire has a unique number associated with it for the entire system:

a. Wire numbers shall correspond to the wire numbers on the control drawings or the panel and circuit numbers for receptacles and lighting.

b. Wire numbers shall correspond to the terminal block number to which they are attached in the control panel.

c. Internal panel wires on a common terminal shall have the same wire number.

Multi-conductor cables shall be assigned a cable number that shall be attached to the cable at intermediate pull boxes and stub-up locations beneath freestanding equipment. All multi-conductor and instrumentation cables shall be identified at pull points as described above:

2. Provide the following wiring numbering schemes throughout the project for field wires:

(ORIGIN LOC.)–(ORIGIN TERM.)/(DEST. LOC.)–(DEST. TERM.)

OR

(ORIGIN LOC.)–(ORIGIN TERM.)
(DEST. LOC.)–(DEST. TERM.)

Where:

ORIGIN LOC	=	Designation for originating panel or device
ORIGIN TERM.	=	Terminal designation at originating panel or device
DEST. LOC.	=	Designation for destination panel or device
DEST. TERM.	=	Terminal designation at destination panel or device or PLC I/O address at destination panel

a. Identify equipment and field instruments as the origin.

b. PCMs are always identified as the destination.

c. Location is the panel designation for VCP, LCP, or PCM. For connections to MCCs, location is the specific starter tag and loop number. Location is the tag and loop number for motor starters, field instruments and equipment. Any hyphen in the panel designation or tag and loop number shall be omitted.

d. Terminal designation is the actual number on the terminal block where the conductor terminates at field devices and vendor control panels. For multi-conductor cables, all terminal numbers shall be shown, separated by commas.

e. Terminal designations at motor leads shall be the motor manufacturer's standard terminal designation (e.g. T1, T2, T3, etc.).

f. Terminal designations at PCMs where the field conductor connects to field terminal blocks for a PLC input or output shall be the PLC address:

1) Point: W-DXSY-Z

Where:
W = PLC number (PLC19, PLC52, PLC71, etc.)
X = PLC Drop number (D1, D2, etc.)
Y = PLC Slot number (S1, S2, etc.)
Z = Terminal number (1, 2, etc. for discrete terminals; use FU1, FU2 for fused terminals; use C1, C2, etc. for common terminals; use SH1, SH2, etc. for shield terminals)

g. Terminal designations at PCMs where the conductor does not connect to a PLC I/O point shall be the terminal number with a “T” prefix (e.g. T0010). For common power after a fuse or neutrals after a switch, the subsequent points shall have and capital letter suffix starting with “A” (e.g. T0010A).

3. Case 1: Vendor control panel (VCP) to process control module (PCM):

Field wire number/label: A-B/C-D
A = Vendor control panel number without hyphen (19VCP4)
B = Terminal number within VCP (manufacturer’s or vendor’s standard terminal number)
C = Process control module number without hyphen (PLC19)
D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a “T” prefix if not connected directly to a PLC I/O point (T0010)

Examples: 19VCP4-10/PLC19-D2S3-1
19VCP4-10/PLC19-D2S8-FU1
19VCP4-10/PLC19-T0100

4. **Case 2**: Field instrument to process control module (PCM):

Field wire number/label: E-F/C-D
C = Process control module number without hyphen (PLC19)
D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a “T” prefix if not connected directly to a PLC I/O point (T0010)
E = Field mounted instrument tag and loop numbers without hyphen (19DSFIT125)
F = Manufacturer’s standard terminal number within instrument. Use both terminal numbers for analog points separated by a comma

Examples: 19DSFIT125-1/PLC19-D2S8-FU1
19DSFIT125-2/PLC19-D2S8-C1
19DSFIT125-SH/PLC19-D2S8-SH1

5. **Case 3**: Motor control center (MCC) to process control module (PCM):

Field wire number/label: G-B/C-D

B = Terminal number within Motor Control Center (manufacturer's or vendor's standard terminal number)

C = Process control module without hyphen (PLC19)

D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "T" prefix if not connected directly to a PLC I/O point (T0010)

G = Actual starter designation in the motor control center without hyphen (19MCC1)

Examples: 19MCC1-09/PLC19-T0101A
19MCC1-10/PLC19-D2S3-1

6. **Case 4**: Motor control center (MCC) to vendor control panel (VCP):

Field wire number/label: G-B/A-B

A = Vendor control panel number without hyphen (19VCP4)

B = Terminal number within motor control center or vendor control panel (manufacturer's or vendors standard terminal number)

G = Actual starter designation in the motor control center without hyphen (19MCC1)

Example: 19MCC1-X2/19VCP4-10

7. **Case 5**: Motor leads to a motor control center (MCC):

Field wire number/label: H-I/G-B

B = Terminal number within motor control center (manufacturer's standard terminal number)

G = Actual starter designation in the motor control center without hyphen (19MCC1)

H = Equipment tag and loop number without hyphen (19DSP121)

I = Motor manufacturer's standard motor lead identification (e.g. T1, T2, T3, etc.)

Example: 19DSP121-T3/19MCC1-T3

8. **Case 6**: Remote or separately mounted starter or variable frequency drive (VFD) to process control module (PCM):

Field wire number/label: J-B/C-D

B = Terminal number within starter or variable frequency drive (manufacturer's standard terminal number)

C = Process control module number without hyphen (PLC19)

D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "T" prefix if not connected directly to a PLC I/O point (T0010)

J = Starter or variable frequency drive tag and loop number without hyphen (19VFD1)

Examples: 19VFD1-09/PLC19-T0101A
19VFD1-10/PLC19-D2S3-1

9. **Case 7**: Field bus trunk segment:

Field cable number/label: C/L/M
C = Process control module without hyphen (PLC19).
L = Field bus segment number.
H = Equipment tag and loop number without hyphen (19MOV04) or

Examples: PLC19/1/19MOV04
19MOV04/2/19MOV05
19MOV05/3/PLC19

10. Identify all spare conductors as required for other field wires with an "S" prefix:

Example: S 19VFD1/ PLC19

D. Equipment Interior Nameplate:

1. For each device with a specific identity (relay, module, power supply, fuse, terminal block, etc.) mounted in the interior of a piece of equipment provide a nameplate located above the device with the inscription as shown in the Contract Documents.

2. Where no inscription is indicated in the Contract documents, furnish nameplates with an appropriate inscription providing the name and number of device used on the Submittal Drawings.

3. Stamp the nameplates with the inscriptions as approved by the Engineer in the submittal.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Nameplates:

a. Color.

1) Nameplate

2) Lettering

b. Size:

1) Outside dimensions.

2) Lettering.

c. Material.

d. Mounting means.

2. Nameplate schedule:

a. Show exact inscriptions for each nameplate for all instruments, panels, enclosures, devices and equipment.

b. Include nameplate dimensions, letter font and letter sizes.

c. Drawing showing locations of nameplates on each panel.

3. Conduit numbers and labels:

a. Submit listing of proposed conduit numbers on a per Area basis.

b. List of proposed conduit numbers shall be provided on electronic spreadsheet, Microsoft Excel.

c. Manufacturer's catalog data for conduit labels.

4. Wire and Cable numbers:

a. Submit listing of wire and cable numbers. For example a multiconductor cable with 7 individual conductors may be cable number "19C123" with wire numbers "19MCC1-10/PLC19-D2S3-1", "19MCC1-11/PLC19-D2S3-2", etc.

b. Submit listing of proposed wire and cable numbers on a per Area basis.

c. List of proposed wire and cable numbers shall be provided on electronic spreadsheet, Microsoft Excel.

d. Medium voltage cables tags shall include cable number, origin/destination and year of install.

e. Type of tie to attach tag to cable for each cable type.

f. Manufacturer's catalog data for wire labels and label printer.

C. Record documents:

1. Update the cable schedule to reflect the exact quantity of wire numbers including spares and destination points for all wires.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 WARRANTY

A. As specified in Section 16050.

1.09 SYSTEM START UP

A. As specified in Section 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Nameplates and signs:

1. One of the following or equal:

a. Brady.

b. Seton.

B. Individual wire markers at termination:

1. Heat-shrinkable tubing:

a. One of the following or equal:

1) Raychem

2) Brady

3) Thomas & Betts

4) Kroy

C. Overall cable and multiconductor markers:

1. One of the following or equal:

a. Lapp Group: Mini System

D. Conduit and raceway markers:

1. One of the following or equal:

a. Almetek: Mini Tags.

b. Lapp Group: Maxi System.

E. Medium voltage raceway voltage markers:

1. One of the following or equal:

a. Almetek: Mini Tags

b. Lapp Group: Maxi System

2.02 MATERIALS

A. Nameplates:

1. Fabricated from black-center, white face laminated plastic engraving stock:

a. 3/32-inch thick material.

b. Two-ply.

c. With chamfered edges.

d. Block style engraved characters of adequate size to be read easily from a distance of 6 feet:

1) No characters smaller than 1/8-inch in height.

e. UV Rated.

2. Caution, warning, and danger nameplates the color shall be red with white lettering.

B. Signs:

1. Automatic equipment and high voltage signs:

a. Suitable for exterior use.

b. In accordance with OSHA regulations.

C. Individual wire markers at termination:

1. Machine printed black characters on white tubing.
2. Ten point type or larger.
3. Origin-destination inscription.

D. Overall cable and multiconductor markers:

1. Non-metallic:
   a. UV resistant holder and letters.
   b. Black letters on yellow background.
   c. Horizontal style.
   d. Letter height: 1/4-inch approximate.
   e. Attach with manufacturer tie wire.
   f. Cable number inscription per Cable Schedule and as assigned by CONTRACTOR.

E. Medium voltage cable raceway markers:

1. Non-metallic:
   a. UV resistant holder and letters.
   b. Black letters on yellow background.
   c. Horizontal style
   d. Letter height: 1/2-inch approximate.
   e. Attach with manufacturer approved black nylon cable tie.

F. Conduit and raceway markers:

1. For exposed conduits:
   a. Non-metallic.
   b. UV resistant holder and letters.
   c. Black letters on yellow background.
   d. Vertical style.
   e. Letter height: 1/2-inch approximate.
   f. Attach with manufacturer tie wire.
   g. Conduit number inscription per Conduit Schedule and as assigned by CONTRACTOR.
2. For conduits that stub up within floor mounted equipment or within handholes and manholes:
   a. Provide phenolic engraved nameplate as specified herein.
   b. Letter height: 1/2-inch approximate.
   c. Conduit number inscription per Conduit Schedule and as assigned by CONTRACTOR.

G. Terminal and junction box markers:

1. Provide phenolic engraved nameplate as specified herein.
2. Letter height: 1/2-inch approximate.
3. Box inscription per Conduit Schedule and as assigned by CONTRACTOR.

H. Equipment Interior Nameplate:

1. Nameplate material shall be clear plastic with black machine printed lettering machine;
2. Caution, warning, and danger nameplates shall have red lettering.
3. The size of the nameplate tape shall be no smaller than ½" in height with 3/8" lettering unless otherwise approved by the Engineer.
4. Securely fasten nameplates in place on a clean surface using the adhesion of the tape. Add additional clear adhesive to hold the nameplate securely in place when necessary.
5. Nameplates shall not be attached to wireway covers or to removable devices.

I. Equipment Tags:

1. The Contractor shall attach a tag to the equipment (including instruments) when there is not adequate room to place a nameplate. Engineer has the final decision regarding whether a nameplate or tag is to be provided.
2. The tag shall be made from 316 stainless steel material and the size of the nameplate shall be no smaller than 3/8"h x 2"w with 3/16" machine printed or engraved lettering unless otherwise approved by the Engineer.
3. The tag shall be attached to the equipment with 316 stainless steel wire of the type normally used for this purpose.
4. SST wire shall be crimp connected. Twisting ends together is not acceptable.

2.03 SOURCE QUALITY CONTROL

A. Nameplates:

1. Provide all nameplates for control panel operator devices (e.g. pushbuttons, selector switches, pilot lights, etc.):
   a. Same material and same color and appearance as the device nameplates, in order to achieve an aesthetically consistent and coordinated system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Nameplates:

1. Attach nameplates to equipment with rivets, bolts or sheet metal screws, approved waterproof epoxy-based cement or install in metal holders welded to the equipment, including NEMA 3R, NEMA 4 or NEMA Type 4x enclosures. Nameplates installed in corrosive or explosion proof areas, use epoxy based cement to attach nameplates.

2. Nameplates for receptacles, can be mounted on wall above receptacle or on receptacle cover plate, as approved by ENGINEER.

3. On conduits that stub up within electrical equipment or within handholes attach phenolic conduit tag nameplate to conduit with stainless steel aircraft cable, crimp connected. For conduits installed flush with inside face of manholes, attach nameplate to concrete manhole with epoxy adhesive just above conduit entrance. ENGINEER to approve epoxy and nameplate location.

4. Nameplates shall be aligned and level or plumb to within 1/64 inch over the entire length:

a. Misaligned or crooked nameplates shall be remounted, or provide new enclosures at the discretion of the ENGINEER.

C. Overall cable and multi-conductor markers:

1. Apply all conductor and cable markers before termination.

2. Attach cable markers, per Manufacturer's instructions or with black nylon cable tie, as approved by ENGINEER.

D. Individual Wire markers:

1. Apply all wire labels before termination.

2. Heat-shrinkable tubing:

a. Tubing shall be shrunk using a heat gun that produces low temperature heated air.

b. Tubing shall be tight on the wire after it has been heated.

c. Characters shall face the open panel and shall read from left to right or top to bottom.

d. Marker shall start within 1/32 inch of the end of the stripped insulation point.

E. Conduit markers:

1. Furnish and install conduit markers for every conduit in the electrical system that is identified in the conduit schedule or part of the process system:

a. Conduit markings shall match the conduit schedule.

2. Mark conduits at the following locations:

   a. Each end of conduits that are greater than 20 feet in length.

   b. Where the conduit penetrates a wall, pull box, vault, junction boxes, manholes, terminal boxes or structure.

   c. Where the conduit emerges from an open transition point, ground, slab, etc.

   d. The middle of conduits that are 20 feet or less in length.

   e. Provide new conduit markers for all existing conduits listed in the Conduit and wire Routing Schedule reused for new work.

3. Mark conduits after the conduits have been fully painted.

4. Position conduit markers so that they are easily read from the floor.

5. Attach conduit markers with nylon cable ties:

   a. Provide ultraviolet resistant cable ties for conduit markers exposed to direct sunlight.

6. Mark conduits before construction review by ENGINEER for punch list purposes.

7. Label intrinsically safe conduits in accordance with the requirements of the National Electrical Code (NEC).

8. Temporary Conduit Labels

   a. Prior to encasement, concealment, backfilling of conduits, temporary conduit labels shall be provided at each end of conduit.

   b. Temporary conduit labels shall be provided on conduits when it leaves an open transition point, junction boxes, terminal boxes, pullboxes, vaults, and manholes, etc.

   c. Temporary conduit labels shall have ½-inch (minimum) lettering at all transition points.

   d. After encasement and concealment temporary conduit labels shall be placed at each exposed end.

F. Signs and labeling:

1. Furnish and install permanent warning signs at mechanical equipment, pumps and motors that may be started automatically or from remote locations:

   a. Fasten warning signs with round head stainless steel screws or bolts.

   b. Locate and mount in a manner to be clearly legible to operations personnel.

2. Furnish and install permanent and conspicuous warning signs on equipment (front and back), doorways to equipment rooms, pull boxes, manholes, fencing, etc. where the voltage exceeds 600 volts.

3. Furnish and install warning signs on equipment that has more than one source of power.

   a. Warning signs to identify every panel and circuit number of the disconnecting means of all external power sources.

4. Place warning signs on equipment that has 120 VAC control voltage source used for interlocking.

   a. Identify panel and circuit number or conductor tag for control voltage source disconnecting means.

3.02 FIELD QUALITY CONTROL

A. Replace any nameplates, signs, conductor markers, cable markers or raceway labels that in the sole opinion of the ENGINEER do not meet the ENGINEER's aesthetic requirements.

END OF SECTION

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SECTION 16123

600 VOLT OR LESS WIRES AND CABLES

PART 1 - GENERAL

A. Section includes:

1. 600 volt class wire and cable.
2. Insulated equipment grounding conductors.
3. Instrumentation class wire and cable.
4. Network cable.
5. Fire alarm wire and cable.
6. Telephone wire and cable.
7. 600 volt class tray cable.
8. 600 volt class armored cable.
9. Resistance Temperature Detector (RTD) cable.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 16050 - Common Work Results for Electrical.
   c. Section 16060 - Grounding and Bonding.
   d. Section 16075 - Electrical Identification.
   e. Section 16950 - Field Electrical Acceptance Testing.

1.02 REFERENCES

A. As specified in Section 16050.

B. ASTM International (ASTM):

1. B 3 - Standard Specification for Soft or Annealed Copper Wire.
2. B 8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. Federal Specification.

1. A-A-59544A - Cable and Wire, Electrical (Power, Fixed Insulation).

D. Insulated Cable Engineers Association (ICEA):

1. NEMA WC 70/ ICEA S-95-658-2009 - Standard for Non-shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.

E. National Fire Protection Association (NFPA):

1. Article 72 - National Fire Alarm and Signaling Code.

2. Article 101 - Life Safety Code.

3. Article 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

F. Telecommunications Industry Association/Electronics Industry Association (TIA/EIA):

1. 568-C.2 - Balanced Twisted-Pair Telecommunication Cabling and Components Standard.

G. Underwriter's Laboratories Inc., (UL):

1. 1063 - Standard for Machine-Tool Wires and Cables.

2. 1277 - Standard for Electrical Power and Control Tray Cables with Optional Optical-fiber Members.

3. 1424 - Standard for Cables for Power-Limited Fire-Alarm Circuits.

4. 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords.

5. 1569 - Standard for Metal-Clad Cables.

6. 2196 - Standard for Tests for Fire Resistive Cables.

7. 2225 - Standard for Cables and Cable-Fittings for Use in Hazardous (Classified) Locations.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Definitions of terms and other electrical considerations as set forth in the:

1. ASTM

2. ICEA

1.04 SYSTEM DESCRIPTION

A. Furnish and install the complete wire and cable system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Manufacturer of wire and cable.

2. Insulation:

a. Type.

b. Voltage class.

3. American wire gauge (AWG) size.

4. Conductor material.

5. Pulling compounds.

C. Shop drawings:

1. Show splice locations as approved.

D. Test reports:

1. Submit test reports for meg-ohm tests.

E. Calculations:

1. Submit cable pulling calculations to the ENGINEER for review and comment for all cables that will be installed using mechanical pulling equipment. Show that the maximum cable tension and sidewall pressure will not exceed manufacturer recommended values:

a. Provide a table showing the manufacturer's recommended maximum cable tension and sidewall pressure for each cable type and size included in the calculations.

2. Submit the calculations to the ENGINEER a minimum of 2 weeks before conduit installation.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. All wires and cables shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 WARRANTY

A. As specified in Section 16050.

1.09 SYSTEM START-UP

A. As specified in Section 16050.

B. All cables to be labeled prior to General Start-Up and Testing Procedures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. 600 volt class wire and cable, insulated equipment grounding conductor:

a. Okonite Company: X-Olene Type XHHW-2 (#8 AWG and larger), Okoseal-N Type THHN/THWN VW-1 (less than #8 AWG), Okoseal-N Type TC (THHN/THWN-2) for multiconductor tray cable.

b. Southwire Company.

c. General Cable.

2. Instrumentation class wire and cable:

a. Okonite Company: Okoseal-N Type P-OS Type TC 600 V rated (tray cables), Type P-OS ITC/PLTC 300 V rated (in conduit).

b. Alpha Wire Company.

c. Belden.

3. Network cables:

a. Belden.

b. Superior Essex Inc.

c. General Cable.

4. Fire alarm wire and cable:

a. Superior Essex Inc.

b. Draka Lifeline

c. West Penn Wire.

5. Telephone wire and cable:

a. Superior Essex Inc.

b. Draka Comteq.

c. General Cable.

6. Tray cables:

a. Okonite.

b. Southwire Company.

c. General Cable

7. Armored cables, or equal.

a. Okonite Company.

b. Southwire Company.

8. RTD cables or equal.

a. Belden: No. 85103.

2.02 MATERIALS

A. Conductors:

1. Copper in accordance with ASTM B. 3.

2.03 MANUFACTURED UNITS

A. General:

1. Provide new wires and cables manufactured within 1 year of the date of delivery to the Site.
2. Permanently mark each wire and cable with the following at 24-inch intervals:
   a. AWG size.
   b. Voltage rating.
   c. Insulation type.
   d. UL symbol.
   e. Month and year of manufacture.
   f. Manufacturer's name.
3. Identify and mark wire and cable as specified in Section 16075:
   a. Use integral color insulation for #2 AWG and smaller wire.
   b. Wrap colored tape around cable larger than #2 AWG.

B. 600 volt class wire and cable, insulated equipment grounding conductor:

1. Provide AWG or kcmil sizes as indicated on the Drawings, or larger if required by submitted equipment:
   a. When not indicated on the Drawings, size wire as follows:
      1) In accordance with the National Electrical Code (NEC):
         a) Use 75 degree Celsius ampacity ratings.
         b) Ampacity rating after all derating factors, equal to or greater than rating of the overcurrent device.
      2) Provide #12 AWG minimum for 600 VAC and less power conductors.
      3) Provide #10 AWG minimum for 125 VDC power conductors.
      4) Provide #14 AWG minimum for control conductors or 24 VDC power conductors.
      5) Provide equipment grounding conductor with minimum size per NEC, or larger if indicated so on the Drawings.
2. Provide Class B stranding per ASTM B 8:
   a. Provide Class C stranding where extra flexibility is required.
3. Insulation:
   a. XHHW-2 for all conductors.
   b. 90 degrees Celsius rating.
4. Multiconductor tray cables:
   a. Number and size of conductors as indicated on the Drawings.

b. Individual conductors with THHN/THWN-2 insulation.

c. Overall PVC jacket.

d. Tray cable rated.

e. Color-coding for control wire per ICEA Method 1, E-2.

f. Ground conductor shall be insulated, green:

g. Sized per NEC

5. Equipment grounding conductor, insulated:

a. Similar to power and control wire.

b. Insulation shall be THHN/THWN-2, green color

C. Instrumentation class cable:

1. Type TC.

2. Suitable for use in wet locations.

3. Voltage rating: 600 volts in cable trays, 300 volts in conduit.

4. Temperature rating:

a. 90 degrees Celsius rating in dry locations.

b. 75 degrees Celsius rating in wet locations.

5. Conductors:

a. Insulation:

1) Flame-retardant PVC, 15 mils nominal thickness, with nylon jacket 4 mils nominal thickness.

b. #16 AWG stranded and tinned.

c. Color code:

1) Pair: Black and white.

2) Triad: Black, white and red.

3) Multiple pairs or triads:

a) Color-coded and numbered.

6. Drain wire:

a. #18 AWG.

b. Stranded, tinned.

7. Jacket:

a. Flame retardant, moisture and sunlight resistant PVC.

b. Ripcord laid longitudinally under jacket to facilitate removal.

8. Shielding:

a. Individual pair/triad:

1) Aluminum foil/polyester tape overlapped to provide 100 percent coverage.

b. Multiple pair or triad shielding:

1) Group shield: Aluminum foil/polyester tape overlapped to provide 100 percent coverage.

2) Completely isolate group shields from each other.

3) Cable shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage.

c. All shielding to be in contact with the drain wire.

D. Network cables:

1. Category 6:

a. General:

1) All Cat 6 cables shall meet the standards set by TIA/EIA-568-C.2, PoE+ - IEEE 802.3 at Type 1 and 2.

2) Use outdoor rated where installed in outdoor or underground conduits or where subject to moisture.

3) Use tray rated with 600 VAC insulation ratings where installed in cable trays.

4) Use shielded Cat 6 cables with 600 VAC insulation ratings where routed within medium voltage switchgear, MCC wireways, between MCC/standalone VFD/soft starter motor starters, etc.

5) Shall have factory made cables with factory installed ends. Custom cables are not acceptable.

b. Conductors:

1) Minimum #24 AWG solid bare copper conductors.

2) 600V rated

c. Insulation:

1) Polyolefin.

2) 4 non-bonded twisted pair cables formed into a cable core.

d. Color code:

1) Pair 1: White/blue stripe and blue.

2) Pair 2: White/orange stripe and orange.

3) Pair 3: White/green stripe and green.

4) Pair 4: White/brown stripe and brown.

e. Outer jacket:

1) PVC with ripcord.

f. Electrical characteristics:

1) Frequency range: 0.772-100 MHz.

2) Attenuation: 32.1 dB/100 m.

3) Near-end crosstalk (NEXT): 39.3 dB.

4) Power sum NEXT: 37.3 dB.

5) Attenuation to crosstalk ratio (ACR): 7.2 dB.

6) Power sum attenuation to crosstalk ratio (PSACR): 5.3 dB/100 m.

7) Equal level far-end crosstalk (ELFEXT): 22.8 dB.

8) Power sum ELFEXT: 19.8 dB/100 m.

9) Return loss: 17.3 dB.

10) Propagation delay: 537 ns/100 m.

11) Delay skew: 45 ns/100 m.

12) Propagation delay (skew), max: 2.5 ns/100 m.

2. Security Cables: per Security System supplier's recommendations.

3. Lighting Control System Cables: per Lighting System supplier's recommendations.

4. RS-485 network cable:

a. Communication wire shall be as recommended and approved by manufacturer of device connected to network.

b. Construction:

1) Shielded twisted conductors.

2) Tinned copper stranded conductors.

3) Insulation:

a) Polyethylene.

b) 300-volt insulation level.

4) Outer shield:

a) 100 percent coverage.

b) Tape/braid.

c) Aluminum foil-polyester tape.

d) Tinned copper braid.

5) Outer shield drain wire:

a) Tinned, copper conductor.

b) Minimum AWG #22.

6) Outer jacket PVC.

7) UL flame tested.

8) Nominal OD 0.284 inch maximum.

9) Provide cable tray rated cables where required.

10) Valve networked cables shall be as required by valve actuator manufacturer; similar to Belden 3105A, or equal. It should be noted that some valve actuator manufacturers require a third wire, CONTRACTOR is required to supply recommended and approved cable.

11) Flow transmitter networked cables shall be as required by transmitter manufacturer; similar to Belden 3105A, or equal.

12) Power quality meter networked cables shall be required by meter manufacturer; similar to Belden 9841, Belden 3105A, or equal.

E. Tray cable:

1. Provide minimum size #1/0 AWG for single wires:

   a. Listed and identified on its surface as suitable for cable tray use, Type TC cable in accordance with the NEC.

2. Provide multi-conductor cable listed and identified on its surface as suitable for cable tray use, Type TC cable in accordance with the NEC.

   a. Provide with an integral white insulated conductor where a neutral is required.

   b. Provide with integral green insulated ground conductor.

3. Provide conductors sized based on ambient temperature adjustment in accordance with the NEC.

F. Fire alarm cable:

1. #18 twisted shielded pair for network cable and as approved by Fire System supplier.

2. Voltage rating: 300 V minimum.

3. Two-hour fire rating per UL 2196.

4. Provide Type FPLP (power-limited plenum rated) for all cabling within ducts, plenums, and all spaces used for air handling:

   a. Cable must meet NEC standards, and must have adequate fire-resistant and low smoke-producing characteristics.

5. Provide Type FPLR (power-limited riser rated) for all vertical runs that pass from floor to floor:

   a. FPLR cable must meet NEC standards, and must have fire-resistant characteristics capable of preventing the carrying of fire from floor to floor.

6. FPL (power-limited general purpose) is only suitable for general-purpose fire alarm use and shall not be used for risers, ducts, plenums, and in air-handling spaces:

a. FPL cable must meet NEC standards, and must be listed as resistant to the spread of fire.

7. Cable substitutions are not permitted unless approved by ENGINEER.

8. Meets code requirements of NFPA 72 and NFPA 101.

9. Conductor insulation:

a. Low smoke PVC.

b. Minimum 105 degrees Celsius rating.

10. Conductor jacket:

a. Low smoke PVC.

b. Ripcord and surface-printed with year of manufacture and cable description at maximum 24-inch intervals.

c. Minimum 105 degrees Celsius rating.

G. Telephone and Paging system cable:

1. Number of twisted pairs: As indicated on the Drawings.

2. Cables to be selected by Telephone and Paging System supplier.

3. Voltage rating: 300 volts.

4. Insulation: Thermoplastic, color coded in accordance with telephone industry standards.

5. Insulation:

a. Non-plenum: High molecular weight polyethylene.

b. Plenum-rated: FEP.

6. Jacket:

a. Non-plenum: PVC.

b. Plenum-rated: Low smoke PVC.

c. Surface-printed with year of manufacture and cable description at maximum 24-inch intervals.

7. Shield: 8 mil aluminum or copper, overlapped to provide 100 percent coverage, covered totally on both sides with copolymer or equal coating able to provide an effective moisture barrier.

8. Conductors: ASTM B3, solid, soft, bare copper.

9. Use minimum #24 AWG conductors, unless otherwise indicated on the Drawings.

10. Twist insulated conductors into pairs with varying lengths of lay.

11. Apply non-hygroscopic core tape over cable core as a dielectric and heat barrier.

12. Provide plenum-rated cable for wiring within ducts, plenums, and all spaces used for air handling.

H. Armored cable:

1. Tight-fitting, continuously welded, corrugated impervious aluminum armor sheath applied over the cable core in accordance with UL 1569.
2. PVC outer jacket.
3. Comply with UL-2225 if within hazardous classification area.
4. For multi-conductor cable, include a separate ground conductor in the cable:
   a. An internal ground conductor may be used, if it is no smaller than indicated on the Drawings, and meets NEC requirements for equipment ground conductor size.
   b. The cable armor is not acceptable as a ground conductor.
5. Rated for 90 degrees Celsius in wet or dry locations.
6. Color-coding for control wire per ICEA Method 1, E-2.
7. Color-coding for power cables as specified above.
8. Individual conductors in accordance with this Specification:
   a. Provide the number and size of conductors as indicated on the Drawings.

I. RTD cable:

1. A RTD cables for motors shall be as required by motor manufacturer to function with RTDs supplied.

2.04 ACCESSORIES

A. Wire ties:

1. One of the following or equal:
2. T&B "Ty-Rap" cable ties.
3. Panduit cable ties.

B. Wire markers:

1. As specified in Section 16075.

2.05 SOURCE QUALITY CONTROL

A. Assembly and testing of cable shall comply with the applicable requirements of ICEA S-95-658-2009.

B. Test Type XHHW-2 in accordance with the requirements of UL 44.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Color-coding:

1. Color-coding shall be consistent throughout the facility.

2. The following color code shall be followed for all 240/120 volt and 208/120 volt systems:
    a. Phase A - Black.
    b. Phase B - Red.
    c. Phase C - Blue.
    d. Single phase system - Black for one hot leg, red for the other.
    e. Neutral - White.
    f. High phase or wild leg - Orange.
    g. Equipment ground - Green.
3. The following color code shall be followed for all 480/277 volt systems:
    a. Phase A - Brown.
    b. Phase B - Orange.
    c. Phase C - Yellow.
    d. Neutral - Gray.
    e. Equipment ground - Green.
4. The following color code shall be followed for all 120 VAC control wiring:
    a. Power - Red.
    b. Neutral - White.
5. The following color code shall be followed for all general purpose DC control circuits:
    a. Ungrounded conductors - Blue
    b. Grounded conductors - White with blue stripe.
6. The following color code shall be followed for all field installed CAT 6 cables:
    a. PLC Panel to SCADA jacks – Orange
    b. PLC Panel to VOIP jacks – White
    c. PLC Panel to DATA jacks – Blue
    d. PLC Panel to Control Network connected panels – Yellow
    e. PLC Panel to Admin Network connected panels – Blue
7. Switch legs shall be violet. Three-way switch runners shall be pink.
8. Wires in intrinsically safe circuits shall be light blue.
9. Wire colors shall be implemented in the following methods:
    a. Wires manufactured of the desired color.
    b. Continuously spiral wrap the first 6 inches of the wire from the termination point with colored tape:

1) Colored tape shall be wrapped to overlap 1/2 of the width of the tape.

C. Install conductors only after the conduit installation is complete, and all enclosures have been vacuumed clean, and the affected conduits have been swabbed clean and dry:

1. Install wires only in approved raceways.

2. Do not install wire:

a. In incomplete conduit runs.

b. Until after the concrete work and plastering is completed.

D. Properly coat wires and cables with pulling compound before pulling into conduits:

1. For all #4 AWG and larger, use an approved wire-pulling lubricant while cable is being installed in conduit:

a. Ideal Products.

b. Polywater Products.

c. Or equal as recommended by cable manufacturer.

d. Do not use oil, grease or similar substances.

E. Cable pulling:

1. Prevent mechanical damage to conductors during installation.

2. For cables #1 AWG and smaller, install cables by hand.

3. For cables larger than #1 AWG, power pulling winches may be used if they have cable tension monitoring equipment.

4. ENGINEER to witness all machine pulled cables.

5. Provide documentation that maximum cable pulling tension was no more than 75 percent of the maximum recommended level as published by the cable manufacturer. If exceeded, the ENGINEER may, at their discretion, require replacement of the cable.

6. Ensure cable pulling crews have all calculations and cable pulling limitations while pulling cable.

7. Make splices or add a junction box or pullbox where required to prevent cable pulling tension or sidewall pressure from exceeding 75 percent of manufacturer’s recommendation for the specified cable size:

a. Make splices in manholes or pull boxes only.

b. Leave sufficient slack to make proper connections.

8. Provide loop of cable within each manhole, encircling three walls minimum.

F. Use smooth-rolling sheaves and rollers when pulling cable into cable tray to keep pulling tension and bending radius within manufacturer’s recommendations.

G. Install and terminate all wire in accordance with manufacturer's recommendations.

H. Electrical identification: Refer to Section 16075.

I. Neatly arrange and lace conductors in all switchboards, panelboards, pull boxes, and terminal cabinets by means of wire ties:

1. Install all wire ties with a flush cutting wire tie installation tool:

a. Use a tool with an adjustable tension setting.

2. Do not leave sharp edges on wire ties.

J. Terminate solid conductors at equipment terminal screws with the conductor tightly wound around the screw so that it does not protrude beyond the screw head:

1. Wrap the conductor clockwise so that the wire loop is closed as the loop is tightened.

2. Do not use crimp lugs on solid wire.

K. Terminate stranded conductors on equipment box lugs such that all conductor strands are confined within the lug:

1. Use ring type lugs if box lugs are not available on the equipment.

L. Splices:

1. Provide continuous circuits from origin to termination whenever possible:

a. Obtain ENGINEER's approval prior to making any splices.

2. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths:

a. Splice box NEMA rating requirements as specified in Section 16050.

b. Make splices in labeled junction boxes for power conductors.

c. Make splices for control and instrument conductors in terminal boxes:

1) Provide terminal boards with setscrew pressure connectors, with spade or ring lug connectors.

3. Power and control conductors routed in common raceways may be spliced in common junction boxes.

4. Clearly label junction and terminal boxes containing splices with the word "SPLICE."

5. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.

6. Install splices with compression type butt splices and insulate using a heat-shrink sleeve:

a. In area subject to moisture, submergence, or rated NEMA 4X; provide heat-shrink sleeves that are listed for submersible applications.

b. Splices to motor leads shall not be heat-shrink type but T&B Shrink-Kon MSC Series, or equal.

7. Splices in below grade pull boxes, in any box subject to flooding, and in wet areas shall be made waterproof using:

a. A heat shrink insulating system listed for submersible applications or an epoxy resin splicing kit.

M. Apply wire markers to all wires at each end after being installed in the conduit and before meg-ohm testing and termination.

N. Instrumentation class cable:

1. Install instrumentation class cables in separate raceway systems from power cables:

a. Install instrument cable in metallic conduit within non-dedicated manholes or pull boxes.

b. Install cable without splices between instruments or between field devices and instrument enclosures or panels.

2. Do not make intermediate terminations, except in designated terminal boxes as indicated on the Drawings.

3. Shield grounding requirements as specified in Section 16060.

O. Multi-conductor cable:

1. Where cable is not routed in conduit with a separate ground conductor, use one conductor in the cable as a ground conductor:

a. Use an internal ground conductor, if it is no smaller than as indicated on the Drawings and meets NEC requirements for equipment ground conductor size.

P. Armored cable:

1. The cable armor is not acceptable as a ground conductor.

2. Where armored cable terminates at a device, switchboard, panel, etc., use armored cable connector.

3. Where armored cable run continues in conduit, strip jacket and armor for portions in conduit, and terminate cable and jacket with an armored cable connector threaded into a coupling or conduit box.

Q. Networked cables:

1. Install network cables for Lighting Control System and Security System per designs and interconnects provided by system supplier and as approved by ENGINEER.

R. Fire alarm cable:

1. Install fire alarm cable in dedicated raceways as designed by Fire Alarm System supplier.

S. Signal cable:

1. Separate and isolate electrical signal cables from sources of electrical noise and power cables by minimum 12 inches.

T. Submersible cable in wet wells:

1. Provide Kellem's-type stainless steel wire mesh grip to support cable weight and avoid stress on insulation. Support stainless steel wire mesh grip off stainless steel channel mounted to interior wall or per ENGINEER.

U. Wiring allowances:

V. Equipment locations may vary slightly from the Drawings. Include an allowance for necessary conductors and terminations for motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of locations indicated on the Drawings.

W. Locations for pull boxes, manholes, and duct banks may vary slightly from the Drawings. Include all costs for necessary conductors, conduits, ductbank, and related materials to adjust locations up to 25 linear feet from locations indicated on the Drawings.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Grounding:

1. As specified in Section 16060.

C. Testing:

1. As specified in Section 16950 and Section 01750.

2. CONTRACTOR may perform megger and continuity testing as outlined in Section 16950. All testing to be witnessed by ENGINEER. NETA Testing Agency shall verify megger and continuity testing results for acceptable levels.

3.03 PROTECTION

A. As specified in Section 16050.

END OF SECTION

SECTION 16125

FIBER OPTIC CABLE AND APPURTENCES

PART 1 - GROUNDING ELECTRODES GENERAL

1.01 SUMMARY

A. Section includes:

1. Fiber optic cable:

a. Fiber splices.

b. Related accessories.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. Refer to Division 17 for fiber patch panels and terminations at PLC Panels. Connectors to be LC type.

4. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

c. Section 16075 - Electrical Identification.

d. Section 16950 - Field Electrical Acceptance Tests.

e. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Route new fiber optic cable networks as indicated on the Drawings.

1.02 REFERENCES

A. Refer to Section 16050.

B. Bellcore Standards:

C. GR-20, "Generic Requirements for Optical Fiber and Optical Fiber Cables."

D. GR-409, "Generic Requirements for Intrabuilding Fiber."

E. Electronic Industry Association (EIA) 455B "Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components":

1. FOTP - 1 Cable Flexing for Fiber Optic Interconnecting Devices.
2. FOTP - 2 Impact Test Measurements for Fiber Optic Devices.
3. FOTP - 3 Procedure to Measure Temperature Cycling Effects on Optical Fibers, Optical Cable, and Other Passive Fiber Optic Components.
4. FOTP - 4 Fiber Optic Connector/Component Temperature Life.
5. FOTP - 5 Humidity Test Procedure for Fiber Optic Connecting Devices.
6. FOTP - 11 Vibration Test Procedure for Fiber Optic Connecting Devices and Cables.
7. FOTP - 17 Maintenance Aging of Fiber Optic Connectors and Terminated Cable Assemblies.
8. FOTP - 18 Acceleration Testing of Fiber Optic Components and Assemblies.
9. FOTP - 21 Mating Durability for Fiber Optic Interconnecting Devices.
10. FOTP - 25 Repeated Impact testing of Fiber Optic Cables and Cable Assemblies.
11. FOTP - 26 Crush Resistance of Fiber Optic Interconnecting Devices.
12. FOTP - 28 Method for Measuring Dynamic Tensile Strength of Optical Fibers.
13. FOTP - 31 Fiber Tensile Proof Test Method.
14. FOTP - 32 Fiber Optic Circuit Discontinuities.
15. FOTP - 33 Fiber Optic Cable Tensile Loading and Bending Test.
16. FOTP - 34 Interconnecting Device Insertion Loss Test.
17. FOTP - 35 Fiber Optic Component Dust (Fine Sand) Test.
18. FOTP - 36 Twist Test for Fiber Optic Connecting Devices.
19. FOTP - 37 Low or High Temperature Bend Test for Fiber Optic Cable.
20. FOTP - 41 Compressive Loading Resistance of Fiber Optic Cables.
21. FOTP - 59 Measurements of Fiber Point Defects Using an OTDR.
22. FOTP - 61 Measurement of Fiber or Cable Attenuation Using an OTDR.
23. FOTP - 78 Spectral Attenuation Cutback Measurement for Single mode Optical Fibers.
24. FOTP - 80 Cutoff Wavelength of Un-cabled Single mode Fiber by Transmitted Power.
25. FOTP - 81 Compound Flow (Drip) Test for Filled Fiber Optic Cable.
26. FOTP - 82 Fluid Penetration Test for Fluid-Blocked Fiber Optic Cable.
27. FOTP - 85 Fiber Optic Cable Twist Test.
28. FOTP - 86 Fiber Optic Cable Jacket Shrinkage.

29. FOTP - 88 Fiber Optic Cable Bend Test.

30. FOTP - 89 Fiber Optic Cable Jacket Elongation and Tensile Strength.

31. FOTP - 91 Fiber Optic Cable Twist-Bend Test.

32. FOTP - 98 Fiber Optic Cable External Freezing Test.

33. FOTP - 169 Chromatic Dispersion Measurement of Single mode Optical Fibers by the Phase-Shift Method.

34. FOTP - 170 Cable Cutoff Wavelength of Single mode Fiber by Transmitted Power.

35. FOTP - 178 Measurements of Strip Force Required for Mechanically Removing Coatings from Optical Fibers.

F. ICEA Standards:

1. S-83-596, “Optic Fiber Premises Distribution Cables.”

2. S-87-640, “Optic Fiber Outside Plant Communications Cable.”

3. S-104-696, “Fiber Optic Premises Distribution Cables.”

G. TIA/EIA Standards:

1. 568-B (Series), Commercial Building Telecommunications Standards.

2. 569 (Series), “Commercial Building Standard for Telecommunications Pathways and Spaces.”

3. 598 “Color Coding of Fiber Optic Cables.”

H. U.S. Department of Agriculture, Rural Electrification Agency REA-PE-90, "Totally Filled Fiber Optic Cable.”

I. NEC OFN-LS/UL 1666 - “Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.”

J. UL 1685 - “Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.”

1.03 DEFINITIONS

A. Refer to Sections 16050 and 17050.

B. Specific Definition:

1. N/Cm: Newtons per centimeter.

1.04 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 16050.

B. Product Data:

1. Complete manufacturer’s brochures that identify materials and options.

2. Completed data sheets, including catalog number and source for determining catalog number.

3. Manufacturer’s installation instructions.

4. Include the following:

   a. Manufacturer's data on testing equipment used on this project.

   b. Manufacturer's specifications and data sheets for all fiber types.

   c. Manufacturer's specifications and data sheets for all connectors, bulkheads, splicing kits, breakout devices, and appurtenances used connecting and terminating the fiber spans.

5. Catalog data on all testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the National Institute for Standards and Testing.

6. Manufacturer's test procedures and quality assurance procedures:

   a. After review, the ENGINEER may require that additional tests be performed before installation.

C. Shop Drawings:

1. Interconnection cabling diagrams for the complete system including every fiber in each cable.

2. Drawings indicating the locations of all pull boxes including pull box identifiers and lengths.

3. Submit optical power budget calculations for all fiber segments. Include the following:

   a. Minimum transmit power of active devices.

   b. Minimum receive sensitivity.

   c. Available power, in dBm.

   d. Loss for each segment in dBm, including cable attenuation and connector losses. Use manufacturer's data for cable attenuation, at the wavelength to be used. Assume 0.5 dB per connector.

   e. Demonstrate that remaining power budget at each receiver is equal to or greater than 3.0 dBm.

D. Installation Instructions:

1. Submit a cable pulling and splicing work plan a minimum of 45 days before the planned initiation of cable pulling. The cable pulling and splicing work plan must be approved a minimum of 15 days before pulling cable. Include the following:

   a. Pull tension calculations.

   b. Detailed description of pull operation methods for all conduit runs.

   c. Tools and equipment to be used for cable installation and testing.

   d. Physical location of equipment setup and type.

   e. Exact locations of splice points.

   f. Safety and manual assist cable-pulling operations.

   g. Detailed schedule for pulling and testing cables.

h. The name and qualifications of the supervisory personnel directly responsible for the installation of the conduit system.

i. Sample fiber optic cable test sheets.

j. All signed test sheet results.

E. Operation and Maintenance Manuals:

1. Compile completed test reports, instruction manuals, and manufacturer's information into the operating manuals and submitted in accordance with Section 01340.

F. Test Reports:

1. Submit the results of all tests specified to the ENGINEER.

2. Submit 3 copies of all test reports showing the results of all tests specified herein or in Section 16950:

a. Test forms shall include the following information at a minimum:

1) Test type.

2) Test location.

3) Test date.

4) Wavelength.

5) Index of refraction.

6) Cable identification.

7) Fiber type.

8) Fiber number.

9) Fiber color.

10) Result of the value of the tested parameter.

3. Furnish hard copy and electronic copy for all OTDR traces.

4. Submit certification that the fiber optic cable has passed each testing stage:

a. Submit separate documentation for each testing stage result.

G. Record Documents:

1. Furnish updated electrical drawings, network diagrams, and fiber cable block diagrams at the end of construction and submit as Record Drawings.

H. Calculations:

1. Cable pulling calculations for all conduit runs:

a. Indicate on the submittal any additional pull boxes that are required, including pull box identifiers and a written description of the location.

1.05 QUALITY ASSURANCE

A. Refer to Section 16050.

B. Furnish all cable and appurtenances manufactured within 1 year of installation.

C. Proof test all optical fibers by the fiber manufacturer at a minimum load of 50 kpsi.

D. Provide 100 percent attenuation testing for all optical fibers:

1. Include with each cable reel the attenuation of each fiber.

E. Provide information on at least 5 successful fiber optic cable installations of comparable size and complexity in the past 3 years with name, address, and telephone number of facility owner, name of project with completion date, and type of conduit system and length of cable pulled.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 16050.

B. Package the cable for shipment on wooden reels:

1. Seal both ends of the cable to prevent the ingress of moisture.

2. Place fiber cable assemblies on reels such that both cable ends are available for testing.

3. Weatherproof cable reel markings shall include the following:

a. Manufacturer.

b. Date of manufacture.

c. Shipping date.

d. Cable identification.

e. Cable configuration/fiber count.

f. Cable length.

g. Gross weight.

h. Cable test date.

i. Handling instructions.

j. Direction to unreel.

1.07 PROJECT OR SITE CONDITIONS

A. Refer to Section 16050.

1.08 SEQUENCING

A. Testing:

1. Perform testing of each fiber in each cable as follows:

a. At the factory before shipment.

b. At the project site upon delivery.

c. After installation, before breakout and terminations.

d. After installation is complete.

2. Submit test reports following each set of tests as specified herein.

B. Notify the ENGINEER and OWNER a minimum of 15 days before post-installation testing.

C. All fiber optic cables shall be tested with results approved by ENGINEER prior to putting in service.

1.09 SCHEDULING

A. Refer to Section 16050.

B. All cables to be labeled prior to General Start-Up and Testing Procedures.

1.10 WARRANTY

A. Refer to Section 16050.

1.11 SYSTEM STARTUP

A. As specified in Section 16050.

B. All fiber cables to be labeled prior to General Start-Up and Testing Procedures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers are indicated with each component type as listed in the remainder of this specification.

2.02 MANUFACTURED UNITS

A. General fiber cable requirements:

1. Suitable for the installed environment.
2. Color-coded fibers according to EIA/TIA-598.
3. Color-coded buffer tubes according to EIA/TIA-598.
4. Furnish buffer tubes of a single layer nylon construction or of a material with similar mechanical performance.
5. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.
6. Utilize a glass reinforced plastic rod as the central anti-buckling member.
7. Apply binders with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes:
   a. Provide binders that are:
      1) Non-hygroscopic.
      2) Non-wicking (or rendered so by the flooding compound).
      3) Dielectric with low shrinkage.
8. Provide a minimum of 1 ripcord under the cable sheath.
9. Provide the high tensile strength Aramid yarns, Kevlar, and/or fiberglass helically stranded evenly around the cable core:

a. No metallic elements whatsoever are allowed in non-armored cable.

10. The jacket or sheath shall be free of holes, splits, and blisters.

11. Mark the jacket or sheath with:

    a. Manufacturer's name.

    b. The words "Optical Cable."

    c. Year of manufacture.

    d. Sequential meter marks.

    e. Repeat markings every 1-meter.

    f. The actual length of the cable to be within 1 percent of the length marking.

    g. The marking must be in a contrasting color to the cable jacket.

    h. The height of the marking:

        1) Approximately 2.5 millimeters.

12. The shipping, storage, and operating temperature range of the cable shall be -40 degrees Celsius to +70 degrees Celsius.

13. General performance characteristics:

    a. The rated tensile load of the cables:

        1) 2,670 N (600 lbf) for armored cables, 1,334 N (300 lbf) for non-armored cables.

        2) Maximum fiber strain within a cable no greater than 60 percent of the fiber proof test level.

    b. Non-armored fiber optic cables: compressive load withstand of 220 N/cm applied uniformly over the length of the cable.

    c. Armored fiber optic cables: compressive load withstand of 440 N/cm applied uniformly over the length of the cable.

    d. The average increase in attenuation for the fibers: <0.10 dB at 1,550 nanometers for a cable subjected to this load:

    e. With no measurable increase in attenuation after load removal.

    f. Test in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cable," except that the load must be applied at the rate of 3 millimeters to 20 millimeters per minute and maintained for 10 minutes.

    g. Capable of withstanding 25 cycles of mechanical flexing at a rate of 30 ± 1 cycles/minute.

    h. The average increase in attenuation for the fibers: < 0.10 dB at 1,550 nanometers at the completion of the test.

    i. For armored cables, any visible cracks causing separation of the armor and propagating more than 5 millimeters constitutes failure.

j. Outer cable jacket cracking or splitting observed under 10X magnification, constitutes failure.

B. Outdoor Fiber Cable:

1. General:

a. Application: Mainly outside of buildings with termination in PLC Panels and or Vendor Control Panels.

b. Refer to Division 17 for termination equipment.

2. Cable Construction:

a. Cable Type: Outdoor and Indoor:

1) Completely preventing the entrance of water.

b. Fiber Count: as indicated on Drawings.

c. Fiber Type: Hybrid cable with number of fibers per type as indicated on Drawings. If not shown on Drawings, provide 24 multimode and 12 single mode type fiber cables.

d. Buffer Tube: Loose Tube.

e. Armoring: None.

f. Strength Member: Central nonmetallic strength member with a coefficient of thermal expansion similar to the fibers.

g. Design and Test Criteria: ICEA-640, and RDUP.

3. Fiber shall be gel free.

4. Manufacturers: One of the following or equal:

a. Corning ALTOS Gel Free Double Jacket Dielectric Fiber Cable, Enhanced

b. Berk-Tek

c. Krone

C. Indoor Cable:

1. General:

a. Application: The interior of structures where exposure to moisture can be minimized.

2. Cable Construction:

a. General:

1) Cable Type: Indoor - Flame Retardant, Low Smoke, Zero Halogen.

2) Fiber Count: as indicated on Drawings.

3) Fiber Type: Hybrid cable with number of fibers per type as indicated on Drawings. If not shown on Drawings provide 24 multimode and 12 single mode type fiber cables.

4) Buffer Tube: Loose Tube.

5) Armoring: None.

6) Strength Member: Central nonmetallic strength member with a coefficient of thermal expansion similar to the fibers.

7) Approvals and Listings: NEC. OFN approved for general purpose indoor applications.

8) Design and Test Criteria: S-83-596.

b. Testing:

1) All fibers in the cable: proof test of 100 kpsi.

2) Each optical fiber: Bellcore GR-409 strip force testing.

3) No gaps are allowed between the coating material and the buffer material, visible under a 50-power microscope.

c. Outer jacket material:

1) Linear low-density polyethylene.

2) Color: Black.

3) Meet all requirements of the NEC for use in all indoor areas without being enclosed in conduit.

4) Flame retardant riser rated conforming to UL 1666.

5) Printed with all necessary UL marks and manufacturer identification.

6) With sequential printing of footage in 2-foot increments.

7) With a ripcord incorporated under the cable jacket.

D. Single Mode Fibers:

1. All fibers in the cable must be usable fibers and meet required specifications.

2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.

3. Single mode fiber characteristics:

a.	Fiber Type:	Single Mode:
b.	Core Diameter:	8.2 +/-2.5 µm.
c.	Clad Diameter:	125 +/- 0.7µm.
d.	Cladding Non-circularity:	< .7 percent.
e.	Numerical Aperture:	14 +/-0.015.
f.	Maximum Attenuation:	.4 dB/km @ 1,310 nm.
		.3 dB/km @ 1,550 nm.
g.	Gigabit Ethernet Distance:	5,000 m @ 1,310 nm.
h.	Coating Diameter:	245 +/- 5 µm.
i.	Cabled Cutoff Wavelength:	< 1,260.

j. Mode-Field Diameter: 9.2 +/- 0.4 µm @ 1,310 nm
10.4 +/- 0.5 µm @ 1,550 nm.

k. Zero Dispersion Wavelength: 1,313 nm.

l. Dispersion Slope: .086 ps/(nm2*km).

E. Multimode Fibers:

1. All fibers in the cable must be usable fibers and meet required specifications.

2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.

3. Multimode fiber characteristics:

a. Fiber Type: Multimode.

b. Core Diameter: 62.5 +/-2.5 µm.

c. Clad Diameter: 125 +/-2.0 µm.

d. Core-to-Cladding Offset: 3.0 µm.

e. Cladding Non-Circularity: < 1 percent.

f. Numerical Aperture: 0.275 +/-0.015.

g. Maximum Attenuation: 3.5 dB/km @ 850 nm.
1 dB/km @ 1,300 nm.

h. Minimum Bandwidth: 200 MHz*Km @ 850 nm.
500 MHz*Km @ 1,300 nm.

i. Coating Diameter: 245 +/- 5 µm.

j. Cabled Cutoff Wavelength: N/A

k. Mode-Field Diameter N/A

l. Zero Dispersion Wavelength: N/A

2.03 ACCESSORIES

A. Splices and enclosures:

1. General:

a. There shall be no field splices allowed unless approved by ENGINEER.

b. The field splices shall connect the fibers of the two fiber optic cables together. The field splices shall be placed in a splice tray, and then the splice tray with splices shall be placed in the splice closure.

c. The fiber optic field splices shall be enclosed in splice closures, which shall be waterproof, rodent proof, and re-enterable, and shall accommodate all the fibers in a single cable. The splice closure shall be suitable for pull box application.

2. Manufacturers: One of the following or equal:

a. Coyote.

B. Patch Cords:

1. General:

a. Connector types to match supplied equipment and existing patch panel terminations, otherwise LC type.

b. Provide 2 spare patch cords (or 1 duplex patch cord) of each type used at each PLC Panel and existing network cabinet.

c. Factory assembled and optically tested.

2. Manufacturers: One of the following or equal:

a. Krone.

b. Corning Cable Systems.

C. Fiber Connectors:

1. All optical fibers shall be pigtail fusion spliced and terminated with a LC duplex type nickel-plated zinc bayonet, zircona ceramic tip, keyed connector. Fiber optic equipment and cable shall use the same type connectors. The connectors shall conform to the following:

a. Attenuation: 0.25 dB typical, 0.75 dB Maximum.

b. Tensile Strength: Less than a 0.2 dB change, based upon a 22 lb. load without adhesive.

c. Temperature Cycling: Less than a 0.3 dB change, based upon -40 degrees C. to +75 degrees Celsius, 100 cycles

d. Humidity: Less than 0.2 dB change, 60 degrees C. at 95% relative humidity for 500 hours.

e. Durability: Less than 0.2 dB change per 1,000 insertions, cleaned every 25th insertion.

D. Fiber Termination Housing:

1. Provide new fiber termination housing at fiber rack in Control Building. Refer to Division 17 for fiber termination housing requirements. All new terminations shall be LC Duplex type connectors. Coordinate location of housing within existing rack with OWNER.

2. Provide all fiber patch cords required to interconnect systems. Control Network fiber patch cords shall be orange. Admin network fiber patch cords shall be yellow.

E. Fiber optic identification markers:

1. UV resistant holder and letters.

2. Black letters on yellow background.

3. Horizontal style.

4. Letter height: 1/4-inch approximate.

5. Attach with manufacturer tie wire.

6. Cable number inscription per Cable Schedule and as assigned by CONTRACTOR.

   a. Lapp Group: Mini System

F. Detectable Pull Tape:

1. Provide detectable pull tape with all fiber cable installations and in all spare fiber conduits.

   a. Manufactured by Neptco Muletape DT1250P or equal.

2.04 SOURCE QUALITY CONTROL

A. Factory Test:

1. Before shipment and while on the shipping reel, test 100 percent of all fibers for attenuation:

2. Copies of the results shall be:

   a. Maintained on file.

   b. Attached to the cable reel in a waterproof pouch.

   c. Submitted before the delivery of the cable to the job site to ENGINEER for approval.

3. Conduct the flex test in accordance with FOTP-104 test condition I and III with a maximum sheave diameter of 20X the cable OD.

4. Verify that the Cable Withstands 25 Impact Cycles with:

   a. The average increase in attenuation for the fibers <0.20 dB at 1,550 nanometers.

   b. No evidence of cracking or splitting.

   c. Conduct the test in accordance with FOTP-25.

5. Certify that the cable withstands a tensile load of 2,700 N (600 pounds):

   a. Without exhibiting an average increase in attenuation of greater than 0.10 dB.

   b. Test in accordance with FOTP-33 using a maximum mandrel and sheave diameter of 560 millimeters.

   c. Apply the load for 1 hour in Test Condition II.

6. Certify that the cable withstands a simulated lightning strike:

   a. Peak value of the current pulse greater than 105kA.

   b. Use a test current with a damped oscillatory maximum time-to-peak value of 15 μs (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz.

   c. The time to half-value of the waveform envelope 40 to 70 μs.

   d. Conduct the test in accordance with the FOTP-181.

e. In addition to the analysis criterion set forth in FOTP-181, the integrity of the buffer tubes (or analogous loose tube, i.e. core tube) and strength members must be intact after removal of the cable specimens from the test box.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify the condition of the conduit system before installation of the fiber optic cable.

B. Pass a test mandrel through all fiber optic conduits prior to pulling fiber.

1. Run the mandrel in both directions.

C. Examine all materials and equipment before installation and verify they are free from physical damage and defects.

3.02 PREPARATION

A. Before fiber splicing terminating or testing activities, verify sufficient workspace is available to perform the activity without interferences from other trades.

B. Pre-Installation Test:

1. Conduct pre-installation tests on all fiber optic cable.

2. Upon arrival at the site:

a. Inspect the cable and reel for damage.

b. Test all fibers with an Optical Time Domain Reflectometer (OTDR) for fiber integrity.

c. Verify that the fiber lengths are consistent with the cable manufacture.

d. Verify that all traces yield no point discontinuities.

3. Complete test sequence and obtain approval from the ENGINEER of submitted test results before cable installation:

a. Replace any cable failing to meet the requirements of the required tests and test before installation.

4. Submit copies of the test results to the ENGINEER within 5 days after the delivery to the site.

3.03 INSTALLATION

A. Refer to Section 16050.

B. Install all fiber optic system components in accordance with the recommendations of the manufacturer.

C. Install fiber optic cable in continuous lengths without splices, except where approved by the ENGINEER.

D. Provide pull tape with metallic detectable strip with each fiber cable installed outdoors and all spare conduits.

E. Installation:

1. Utilize personnel certified by the manufacturer with specific knowledge of the cable manufacturer's recommended procedures:

   a. Schedule ENGINEER, 5 days before installation, to witness all cable installations.

2. Properly attach the fiber optic cable's strength elements to a 600-pound breakaway swivel containing tension or shear pins using Kellums pulling grips that are a minimum of 18 inches long.

3. Certify that cable tensile limits do not exceed cable pull tension and bend limits using tension monitoring devices.

4. Leave an extra loop of fiber optic cable in each pull box.

5. Conform with the cable manufacturer's specifications, practices, and the following requirements:

   a. When power equipment is used to install fiber optic cables, use low speeds and do not exceed a rate of 30 meters per minute.

   b. Do not exceed the tensile and bending limitation for fiber optic cables under any circumstances.

   c. Use large diameter wheels, pulling sheaves, and cable guides to maintain the specified bending radius.

   d. Use commercial dynamometers or load cells to monitor pulling tension.

   e. A nonfreezing type of swivel inserted between the pulling line and cable pulling grip to prevent twisting under strain.

   f. All cable to be installed using a breakaway swivel.

6. Apply to all conduits a lubricant at each conduit ingress and egress location during the pull operation:

   a. Pour or pump lubricant into the end of the conduit at the feed location at a nominal application rate of 3 gallons per 1,000 feet of cable.

   b. If the conduit is open at intermediate locations, then apply the appropriate proportion of lubricant at each opening.

   c. Continuously lubricate the cable as it is being pulled by pouring or pumping the lubricant into the conduit at the feed location and at each intermediate location.

   d. Station workers at each intermediate location as required.

   e. Remove all excess lubricant that has collected.

   f. Remove and clean the surrounding area after cable installation.

7. Install using a hydraulic capstan or winch equipped with a recording running line dynamometer graph which measures and records pulling tensions:

a. Use pulling equipment with “slip-load” capability to allow the winch to maintain a constant pulling force without taking up the winch line.

b. Use pulling equipment equipped with a hydraulic bypass set so that a maximum tension of 600 pounds is not exceeded.

c. Use only equipment designed to prevent a preset pulling tension from being exceeded.

d. Fiber optic cable manufacturer to provide the pulling tension setpoint.

e. If during the pulling operation excessive tension is detected, cease all operations and notify the ENGINEER.

8. Position the cable reel at the feed point in alignment with the raceway and in such a position that the cable can be passed from the top of the reel in a long, smooth bend into the raceway system:

   a. The use of a cable feeder is required.

9. Supply all bull wheels, blocks, split wheels, cable feeders, and necessary equipment required to provide a clean and safe operation:

   a. The cable shall not be allowed to travel over any wheel or block that has a radius less than the minimum radius allowed by the cable manufacturer.

10. Minimize the use of snatch blocks and rollers to guide the cable into the conduit at the feed point:

    a. Slack feed by hand the cable into the feed point and raceway without the use of rollers.

11. Tend the cable reel at all times and turn by hand to provide the required cable slack:

    a. Under no circumstances shall the cable tension be allowed to turn the cable reel.

12. Use a rim roller, with a wheel radius greater than the minimum cable bending radius placed at the manhole or vault opening to prevent the cable from dragging on the manhole rim or steps.

13. Perform a continuous thorough visual inspection for flaws, breaks, and abrasions in the cable sheath as the cable leaves the reel, and maintain a slow pulling speed to permit this inspection.

14. Damage to the sheath or finish of the cable is cause for rejecting the cable:

    a. Replace any cable damaged in any way during installation.

15. If the cable becomes damaged during installation, stop operations and notify the ENGINEER immediately:

    a. ENGINEER to determine whether to replace the entire reel of cable or to install a termination panel to eliminate the damaged section.

16. Document all pulls by a graph which is annotated with the following information:

a. Reel number.

b. Pull point ID.

c. Date and time.

d. Explanations for abnormalities in readings or interruptions.

e. Sign-off by CONTRACTOR and ENGINEER.

17. Under no conditions shall the fiber optic cable be left exposed or unattended.

F. After the cables are installed and spliced:

1. Rack the cables.

a. Loosely secure in racked position with wire ties.

b. Attach fiber markers to each cable in each handhole and manhole.

G. Splices:

1. Splices are not allowed unless approved by ENGINEER. System is designed for continuous fiber cable runs from panel to panel complete.

2. Submit all splice locations to the ENGINEER for approval before installation of the fiber cables.

3. Provide approved field splices in a splice tray located in a waterproof splice enclosure:

a. Splice enclosure manufactured by Tyco/Raychem FOSC style splice enclosure, or equal.

4. Loop the individual fibers a minimum of 1 full turn within the splice tray to avoid macro/micro bending.

5. After completion of cable terminations, neatly dress all cables.

6. Protect all splices with a thermal shrink sleeve.

7. Provide fusion type fiber optic cable splicing meeting the following requirements:

a. Joins multimode or single mode fibers.

b. Establishes a permanent fusion splice.

c. Waterproof.

d. Re-enterable, rearrangable, and reusable.

e. Splice loss < 0.10 dB.

f. Protected by a splice enclosure.

8. Requirement for outdoor fiber splice enclosures:

a. Seal.

b. Bond.

c. Anchor.

d. Protect fiber optic cable splices.

e. Stand-alone unit that does not require an outer enclosure.

f. Provide for a maximum of 6 cable entries in a butt-end configuration.

g. Used in aerial, underground, and direct buried applications.

9. Requirement for indoor fiber splice enclosures:

a. Anchor.

b. Protect fiber optic cable splices.

c. Stand-alone unit that does not require an outer enclosure.

d. Suitable for the minimum number of splices at that location plus additional capacity for reconfigurations.

10. Re-splice any splice that has a loss greater than 0.10 dB.

11. Leave a minimum of 20 feet of fiber optic cable at each end of splice, or lengths as approved by ENGINEER.

H. Labeling:

1. Affix overall fiber cable markers to all fiber cables at all fiber terminations.

2. Provide labeling of overall fiber cables, providing origin/destination label of fiber cable at patch panel.

3. Provide schedule of individual fiber use, by pairs, within patch panel swing door. For example, if fibers 1 and 2 are used for connecting Dewatering Building Control Network Switch to Operations Building Control Network Switch, complete schedule for fibers 1 and 2 as “Dewatering Bldg. Control Switch to Ops Bldg. Control Switch”. If fibers 3 and 4 are spare, complete schedule for fibers 3 and 4 as “spare”.

3.04 FIELD QUALITY CONTROL

A. Refer to Section 16050 and Section 01750.

B. Label all fiber cables and complete fiber schedules in all termination cabinets per Section 16075.

C. General:

1. All test results shall meet or exceed manufacturer specifications:

a. Test each fiber of each cable for breaks, abnormalities, and overall attenuation characteristics.

b. Replace any fiber that does not meet or exceed manufacturer specifications.

2. Conduct post-installation tests of the fiber optic system in accordance with Section 16950 and this Section.

3. Pre-installation tests and post-installation tests to be witnessed and signed off by ENGINEER and OWNER.

4. Perform attenuation tests with an Optical Loss Test Set capable and calibrated to show anomalies of 0.1 dB as a minimum:

a. Test multimode fibers at 850 nanometers and 1,300 nanometers.

b. Test single mode fibers at 1,310 and 1,550 nanometers.

5. Perform OTDR tests on fiber cables less than 100 meters with the aid of a launch cable:

a. Adjust OTDR pulse width settings to a maximum setting of 1/1,000th of the cable length or 10 nanoseconds.

6. Tests shall be part of General Start-Up and Testing Procedures per Section 01750.

3.05 CLEANING

A. Clean all fiber optic connectors after termination and before testing. After cleaning, cover all un-terminated connectors with a protective boot.

B. At the completion of construction, touch up the finish on all fiber patch panels and enclosures.

3.06 PROTECTION

A. Refer to Section 16050.

B. Protect the fiber system from physical damage and the encroachment of dust, before, during and after installation.

END OF SECTION

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SECTION 16130

CONDUITS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Metallic conduits:

a. Rigid galvanized steel (GRS).

b. Polyvinyl chloride coated rigid steel (GRS-PVC).

c. Liquid-tight flexible metal (FLEX).

2. Nonmetallic conduits:

a. Rigid nonmetallic (PVC).

3. Conduit bodies.

4. Conduit fittings and accessories.

5. Conduit installation.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

c. Section 16070 - Hangers and Supports.

d. Section 16075 - Electrical Identification.

e. Section 16133 - Duct Banks.

1.02 REFERENCES

A. As specified in Section 16050.

B. American National Standards Institute (ANSI):

1. C80.1 - Electrical Rigid Steel Conduit.

2. C80.3 - Steel Electrical Metallic Tubing.

3. C80.6 - Electrical Intermediate Metal Conduit.

C. National Electrical Manufacturer's Association (NEMA):

1. RN-1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Steel Conduit.
2. TC2 - Electrical Polyvinyl Chloride (PVC) Conduit.
3. TC3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

D. Underwriters Laboratories (UL):

1. 1 - Standard for Flexible Metal Conduit.
2. 6 - Standard for Electrical Rigid Metal Conduit - Steel.
3. 360 - Standard for Liquid-Tight Flexible Steel Conduit.
4. 651 - Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
5. 797 - Standard for Electrical Metallic Tubing - Steel.
6. 1660 - Standard for Liquid-Tight Flexible Nonmetallic Conduit.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions and abbreviations:

1. Conduit bodies: A separate portion of a conduit system that provides access through a removable cover to the interior of the system at a junction of 2 or more conduit sections. Includes, but not limited to: shapes C, E, LB, T, X, etc.
2. Conduit fitting: An accessory that serves primarily a mechanical purpose. Includes, but not limited to: bushings, locknuts, hubs, couplings, reducers, etc.
3. GRC: Galvanized rigid steel conduit.
4. GRS-PVC: PVC coated rigid steel conduit.
5. EMT: Electrical metallic tubing. – EMT conduit is not allowed on this project
6. PVC: Polyvinyl chloride rigid nonmetallic conduit.
7. FLEX: Sealtight - liquid-tight flexible conduit.
8. NPT: National pipe thread.

1.04 SYSTEM DESCRIPTION

A. Provide conduits, conduit bodies, fittings, junction boxes and all necessary components, whether or not indicated on the Drawings, as required, to install a complete electrical raceway system.

B. Provide conduits, conduit bodies, fittings, enclosures, pull boxes, manholes, trenching, and all necessary components, whether or not indicated on the Drawings, as required per SMUD, to install work required by SMUD as shown on Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Furnish complete manufacturer's catalog sheets for every type and size of conduit, fitting, conduit body, and accessories to be used on the Project.

2. Furnish complete manufacturer's recommended special tools to be used for installation if required.

C. Installation Drawings:

1. Dimensioned layout drawings of all cable tray routings, including elevations.

D. Record Documents:

1. Incorporate all changes in conduit routing on electrical plan drawings.

2. Dimension underground and concealed conduits from building lines.

3. Furnish hard copy drawings and electronic files in AutoCAD Version 2010.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. All conduits, conduit bodies, and fittings shall be UL listed and labeled.

C. All conduits to be labeled. Refer to Section 16075. Where there is no conduit tag shown on the Contract Drawing, the CONTRACTOR shall submit proposed conduit tag for ENGINEER approval.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

B. Do not store or expose type PVC to direct sunlight.

C. Do not store conduit in direct contact with the ground.

1.08 PROJECT OR SITE CONDITIONS

A. Refer to Section 16050.

1.09 SEQUENCING

A. Before installing any conduit or locating any device box:

1. Examine the complete set of Drawings and Specifications, and all applicable shop drawings.

2. Verify equipment conduit windows and thus placement of conduit stub ups are not in conflict with structural supports of said equipment.

3. Verify all dimensions and space requirements and make any minor adjustments to the conduit system as required to avoid conflicts with the building structure, other equipment, or the work of other trades.

1.10 WARRANTY

A. Refer to Section 16050.

1.11 SYSTEM STARTUP

A. As specified in Section 16050.

B. All conduits to be labeled prior to General Start-Up and Testing Procedures.

PART 2 - PRODUCTS

A. Galvanized rigid steel conduit (GRC):

1. One of the following or equal:

a. Western Tube and Conduit.

b. Allied Tube and Conduit.

c. Wheatland Tube Co.

B. Polyvinyl chloride coated rigid steel conduit (GRS-PVC):

1. One of the following or equal:

a. Robroy Industries.

b. Ocal, Inc.

c. Perma Kote.

C. Electrical metallic tubing (EMT): - EMT is not allowed on this project

D. Flexible metallic conduit (FLEX):

1. One of the following or equal:

a. Anamet Anaconda Sealtite Type UA.

b. Electri-flex Type LA.

E. Rigid nonmetallic polyvinyl chloride conduit (PVC):

1. One of the following or equal:

a. Carlon.

b. Cantex.

c. PW Eagle.

F. Conduit bodies:

1. One of the following or equal:

a. Crouse-Hinds.

b. Appleton.

c. O-Z/Gedney.

d. Ocal.

e. Robroy.

f. Carlon.

G. Galvanized rigid steel conduit expansion fittings:

1. One of the following or equal:

a. Crouse-Hinds.

b. Appleton.

c. O-Z/Gedney.

H. Conduit sleeve:

1. One of the following or equal:

a. Crouse-Hinds.

b. Appleton.

c. O-Z/Gedney.

I. Conduit seals:

1. One of the following or equal:

a. Appleton.

b. Crouse-Hinds.

c. O-Z/Gedney.

J. Conduit hangers and supports:

1. As specified in Section 16070.

K. Conduit through wall and floor seals:

1. The following or equal:

a. O-Z/Gedney:

1) Type "WSK."

2) Type “CSM.”

2.02 COMPONENTS

A. Galvanized rigid steel conduit (GRS):

1. All threads: NPT standard conduit threads with a 3/4-inch taper per foot:

a. Running conduit threads are not acceptable.

2. Hot-dip galvanized inside and out:

a. Ensures complete coverage and heats the zinc and steel to a temperature that ensures the zinc alloys with the steel over the entire surface.

b. Electro-galvanizing is not acceptable.

3. Manufactured in accordance with:

a. UL-6.

b. ANSI C80.1.

B. Polyvinyl chloride coated rigid steel conduit (GRS-PVC):

1. The steel conduit, before PVC coating, shall be new, unused, hot-dip galvanized material, conforming to the requirements for type GRC.

2. Coated conduit conforms to NEMA Standard RN-1:

   a. The galvanized coating may not be disturbed or reduced in thickness during the cleaning and preparatory process.

3. Factory bonded PVC jacket:

   a. The exterior galvanized surfaces shall be coated with primer before PVC coating to ensure a bond between the zinc substrate and the PVC coating.

   b. Nominal thickness of the exterior PVC coating shall be 0.040 inch except where part configuration or application of the piece dictate otherwise.

   c. PVC coating on conduit and associated fittings shall have no sags, blisters, lumps, or other surface defects and free of holes and holidays.

   d. The PVC adhesive bond on conduit and fittings shall be greater than the tensile strength of the PVC plastic coating:

      1) Confirm bond with certified test results.

4. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings:

   a. Nominal thickness of 0.002 inch.

   b. Conduit having areas with thin or no coating are not acceptable.

   c. All threads shall be coated with urethane.

5. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperature above 30 degrees Fahrenheit (-1 degree Celsius).

C. Electrical metallic tubing (EMT): - EMT is not allowed on this project

D. Flexible metallic conduit (FLEX):

1. Temperature rated for use in the ambient temperature at the installed location but not less than the following:

   a. General purpose:

      1) Temperature range -20 degrees Celsius to +80 degrees Celsius.

   b. Oil resistant:

      1) Temperature range -20 degrees Celsius to +60 degrees Celsius.

2. Sunlight resistant, weatherproof, and watertight.

3. Manufactured from single strip steel, hot-dip galvanized on all 4 sides before conduit fabrication.

4. Strip steel spiral wound resulting in an interior that is smooth and clean for easy wire pulling.

5. Overall polyvinyl chloride jacket.

6. With integral copper ground wire, built in the core, in conduit trade sizes 1/2 inch through 1-1/4 inch.

E. Rigid nonmetallic polyvinyl chloride conduit (PVC):

1. Extruded from virgin polyvinyl chloride compound:

a. Schedule 40 unless otherwise specified.

b. Schedule 80 extra heavy wall where specified.

2. Rated for 90 degrees Celsius conductors or cable.

3. Rated for use in direct sunlight.

4. PVC conduit utilized for directional drilling shall include non-cement, locking, and water-proof joints.

F. Conduit bodies:

1. Material consistent with conduit type:

a. Malleable iron bodies and covers when used with type GRC conduit.

b. PVC-coated malleable iron bodies and covers when used with type GRS-PVC. The PVC coating on the outside of conduit bodies shall be 0.040 inch thick and have a series of longitudinal ribs to protect the coating from tool damage during installation. The PVC coating on the inside of conduit bodies shall be 0.002 inch interior urethane coating. Utilize the PVC coating as an integral part of the gasket design. Stainless steel cover screws heads shall be encapsulated with plastic to assure corrosion protection. A PVC sleeve extending 1 conduit diameter or 2 inches, whichever is less, shall be formed at each female conduit opening. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used. The sleeve shall provide a vapor and moisture tight seal at every connection.

c. PVC bodies and covers when used with type PVC.

2. Conduit bodies to conform to Form 8, Mark 9, or Mogul design. Form 7 conduit bodies are not allowed:

a. Mogul design conforming to NEC requirements for bending space for large conductors for conduit trade sizes of 1 inch and larger with conductors #4 AWG and larger, or where required for wire bending space.

3. Gasketed covers attached to bodies with stainless steel screws secured to threaded holes in conduit body.

2.03 ACCESSORIES

A. Connectors and fittings:

1. Manufactured with compatible materials to the corresponding conduit.

B. Insulated throat grounding metallic bushings:

1. Construction:

a. Zinc plated malleable iron when used with steel conduit.

b. Positive metallic conduit end stop.

c. Integrally molded non-combustible phenolic insulated surfaces rated 150 degrees Celsius.

d. Threaded type grounding lug, rated for copper grounding conductor.

e. UL File No. E-6225.

C. Nonmetallic end bells and bushings:

1. Construction:

a. Use end bells on all nonmetallic conduit system that terminate in manholes or handholes or stub up into electrical equipment.

b. Use fully insulated bushings on nonmetallic conduit system made of high impact 150 degrees Celsius rated non-combustible thermosetting phenolic.

D. Electrical unions (Erickson Couplings):

1. Construction:

a. Malleable iron for use with steel conduit.

b. Concrete tight, 3-piece construction.

c. Rated for Class I Division 1 Group D in hazardous areas.

E. FLEX fittings:

1. Construction:

a. Malleable iron.

b. Furnished with locknut and sealing ring.

c. Liquid-tight, rain-tight, oil-tight.

d. Insulated throat.

e. Furnish as straight, 45-degree elbows and 90-degree elbows.

f. Designed to prevent sleeving:

1) Verify complete bonding of the raceway jacket to the plastic gasket seal.

g. Equipped with grounding device to provide ground continuity irrespective of raceway core construction. Grounding device, if

inserted into raceway and directly in contact with conductors, shall have rolled over edges for sizes less than 5 inches.

h. Where terminated into a threadless opening using a threaded hub fitting, a suitable moisture resistant/oil resistant synthetic rubber gasket shall be provided between the outside of the box or enclosure and the fitting shoulder. Gasket shall be adequately protected by and permanently bonded to a metallic retainer.

2. Corrosion resistant and outdoor FLEX fittings:

a. Construction:

1) PVC-coated liquid-tight fittings with a bonded 0.040-inch thick PVC coating on the metal connector to form a seal around the FLEX conduit.

2) Insulated throat and an integral sealing ring.

F. Hubs for threaded attachment of steel conduit to sheet metal enclosures:

1. Construction:

a. Insulated throat.

b. PVC coated when used in corrosive areas.

c. Bonding locknut.

d. Recessed neoprene O-ring to assure watertight and dust-tight connector.

e. One half (1/2)-inch through 1-1/4-inch steel zinc electroplated.

f. One and one half (1-1/2)-inch through 6-inch malleable iron zinc plated.

g. Aluminum with aluminum conduit.

2. Usage:

a. All conduits in damp, wet, outdoor, and corrosive areas shall use threaded hubs for connections to sheet metal enclosures.

G. Sealing fittings:

1. Construction:

a. 40 percent wire fill capacity.

b. PVC-coated when used in corrosive areas.

c. Malleable ductile iron with steel conduit.

d. Crouse-Hinds Type EYD where drains are required.

e. Crouse-Hinds Type EYS where drains are not required.

f. UL listed for use in Class I, Division 1, Groups A, B, C, D; Class I, Division 2, Groups A, B, C, D; Class II, Divisions 1 and 2; Groups E, F, and G.

2. Sealing compound:

a. Fiber filler and cement as recommended by the sealing fitting manufacturer.

b. Approved for the conditions and use.

1) Not affected by surrounding atmosphere or liquids.

c. Melting point shall be 200 degrees Fahrenheit minimum.

H. PVC fittings:

1. Shall include the following:

a. Couplings.

b. Terminal adapters.

c. Female adapters.

d. Caps.

e. Reducer bushings.

f. Duct couplings.

g. End bells.

h. Expansion couplings.

i. Duct couplings 5 degree.

j. C - pull fittings.

k. E - pull fittings.

l. LB - pull fittings.

m. LL - pull fittings.

n. LR - pull fittings.

o. T - pull fittings.

p. X - pull fittings.

q. Service entrance caps.

2. Materials:

a. All devices shall be made of PVC, using the same materials as used for Type PVC conduit.

b. All metal hardware shall be stainless steel.

I. Through wall and floor seals:

1. Materials:

a. Body: casting of malleable or ductile iron with a hot-dip galvanized finish.

b. Grommet: neoprene.

c. Pressure rings: PVC coated steel.

d. Disc material: PVC coated steel.

J. Expansion/deflection couplings:

1. Use to compensate for movement in any directions between 2 conduit ends that they connect.
2. Shall allow movement of 3/4 inch from the normal in all directions.
3. Shall allow angular movement for a deflection of 30 degrees from normal in any direction.
4. Constructed to maintain electrical continuity of the conduit system.
5. Materials:
   a. End couplings: Bronze or galvanized ductile iron.
   b. Sleeve: Neoprene.
   c. Bands: Stainless steel.
   d. Bonding jumper: Tinned copper braid.

K. Expansion couplings:

1. Shall allow for expansion and contraction of conduit:
   a. Permitting 4-inch movement, 2 inches in either direction.
2. Constructed to maintain electrical continuity of the conduit system.
3. Materials:
   a. Head: Malleable or ductile iron.
   b. Sleeve: Steel.
   c. Insulating bushing: Phenolic.
   d. Finish: Hot-dip galvanized.

L. Transition from underground to exposed:

1. Provide GRS-PVC factory elbows to transition from underground to exposed.
2. For medium voltage conduit systems provide GRS-PVC 90 degree sweeps. For less than 4-inch medium voltage conduits provide 24” minimum radius 90 degree sweeps. For 4 inch and larger medium voltage conduits provide 36” minimum radius 90 degree sweeps.

M. Conduit markers:

1. As specified in Section 16075.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 16050.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. General:

1. Conduit routing:

a. The Electrical Drawings are diagrammatic in nature:

1) Install conduit runs as specified with schematic representation indicated on the Drawings and as specified.

2) Modify conduit runs to suit field conditions, as accepted by the ENGINEER:

a) Make changes in conduit locations that are consistent with the design intent but are dimensionally different, or routing to bypass obstructions.

b) Make changes in conduit routing due to the relocation of equipment.

3) The Drawings do not indicate all required junction boxes and pull boxes:

a) Provide junction boxes and pull boxes to facilitate wire pulling as required:

(1) To meet cable manufacturer's pulling tension requirements.

(2) To limit total conduit bends between pull locations.

b) Install junction boxes and pull boxes at locations acceptable to the ENGINEER.

b. The CONTRACTOR is responsible for any deviations in general location, conduit size, routing, or changes to the conduit schedule without the express written approval or direction by the ENGINEER:

1) The ENGINEER is the sole source in determining whether the change is constituted as a deviation:

2) Perform any changes resulting in additional conduits, or extra work from such deviations.

3) Incorporate any deviations on the Record Documents.

4) Vertical offsets and sloping of conduits are not detailed on plans; the Electrical Contractor shall include in his bid the price for the complete conduit run utilizing the civil & mechanical plans to measure vertical & slope distances.

c. OWNER reserves the right to deduct the amount of applicable reimbursement, equivalent to the cost of the engineering effort required to show those unauthorized changes on Record Drawings.

d. Exposed conduits runs shall not be run directly on the ground. Secure conduits to stainless steel unistrut.

2. Use only tools recommended by the conduit manufacturer for assembling conduit system.

3. Provide adequate clearances from high-temperature surfaces for all conduit runs. Provide minimum clearances as follows:

   a. Clearances of 6 inches from surfaces 113 degrees Fahrenheit to 149 degrees Fahrenheit.

   b. Clearances of 12 inches from surfaces greater than 149 degrees Fahrenheit.

   c. Keep conduit at least 6 inches from the coverings on hot water and steam pipes, 18 inches from the coverings on flues and breechings and 12 inches from fuel lines and gas lines.

   d. Where it is necessary to route conduit close to high-temperature surfaces, provide a high-reflectance thermal barrier between the conduit and the surface.

4. Support conduit runs on water-bearing walls a minimum of 7/8-inch away from wall on an accepted preformed channel:

   a. Do not run conduit within water-bearing walls unless otherwise indicated on the Drawings.

5. Do not install 1 inch or larger conduits in or through structural members unless approved by the ENGINEER.

6. Run conduit exposed to view parallel with or at right angles to structural members, walls, or lines of the building:

   a. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends.

   b. Make changes in direction with long radius bends or with conduit bodies.

7. Install conduit with total conduit bends between pull locations less than or equal to 270 degrees.

8. Route all exposed conduit to preserve headroom, access space and work space and to prevent tripping hazards and clearance problems:

   a. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and do not block or interfere with ingress or egress, including equipment removal hatches.

   b. Route conduit to avoid drains or other gravity lines. Where conflicts occur, relocate conduit as required.

9. Conduit may be run in concrete members or slabs with permission of the ENGINEER:

   a. Refer to the typical details for conduit spacing and size requirements.

10. When installing conduit through existing slabs or walls make provisions for locating any possible conflicting items where conduit is to penetrate. Use tone signal or X-ray methods to make certain that no penetrations will be made into existing conduit, piping, cables, post-tensioning cables, etc.

11. Install duct seal within all conduits inside a structure or buildings where the conduit is routed from outside structure or building.

12. Install duct seal within all conduits at pull boxes, manholes, handholes for conduits that are routed inside structure or building.

13. For all existing conduit runs and new 2-inch and larger conduit runs, snake conduits with conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of conduit:

    a. Remove and replace conduits through which mandrel will not pass.

14. Provide all sleeves and openings required for the passage of electrical raceways or cables even when these openings or sleeves are not specifically indicated on the Drawings.

15. Install complete conduit systems before conductors are installed.

16. Provide metallic conduits terminating in transformer, switchgear, switchboard, motor control center, panelboard, control panels or other electrical equipment where maximum voltage within equipment is greater than 120 VAC, with insulated throat grounding bushings. Medium voltage conduit system insulated throat grounding bushings shall be connected to equipment ground bus with a minimum No. 6 AWG ground wire. 600 Volt and below conduit system insulated throat grounding bushings shall be connected to equipment ground bus with a minimum No. 10 AWG ground wire. Provide insulated throat grounding bushings on all 125 VDC systems.

17. Provide metallic conduits terminating in electrical equipment where maximum voltage within equipment is equal to or less than 120 VAC, with insulated throat grounding bushings.

18. Underground and embedded conduits:

    a. Install underground conduits, including conduit runs below slabs-on-grade in concrete-reinforced duct bank construction:

        1) As specified in Section 16133.

    b. Make underground conduit size transitions at pullboxes and manholes.

    c. Install spare conduits in underground duct banks towards top center of runs to allow for ease of installation of future cables as conduits enter underground manholes and pullboxes.

19. All spares shall be mandrel and have pull ropes installed.

20. Conduits shall be painted to match the color of surface attached to as directed by Owner.

21. All existing conduits that are reused shall have a mandrel pulled through the entire conduit run to prove the length contains no blockages or obstructions. Mandrelling shall be witness by the Owner.

C. Lighting and receptacle conduits:

1. Install conduit runs for lighting and receptacle circuits, whether or not indicated on the Drawings:

a. Minimum conduit size:

1) 3/4 inch for exposed conduits.

2) 3/4 inch for within slab or wall conduits.

3) 1 inch for underground conduits.

2. Provide conduit materials for the installed location as specified in Section 16050.

3. Areas 15, 17, 18, 19 (hydraulic walls), 42 and 51 shall have wiring devices installed within exposed surface mounted cast boxes with threaded fittings. Refer to Drawings if wiring device cast box is to be polyvinyl chloride coated.

4. Areas 19 (non-hydraulic walls), 71 and 96 shall have wiring devices installed within recessed box (cast within wall) for flush mounted arrangement.

5. All other Areas not shown above shall have wiring devices installed within exposed surface mounted cast boxes with threaded fittings. Refer to Drawings if wiring device cast box is to be polyvinyl chloride coated.

D. Conduit usage:

1. Exposed outdoor conduits:

a. Polyvinyl chloride coated rigid steel conduit:

1) Install polyvinyl chloride coated rigid steel conduit type for all exposed conduits outdoors.

2) Minimum Size: 3/4 inch.

2. Exposed indoor conduits:

a. Polyvinyl chloride coated rigid steel conduit:

1) Install polyvinyl chloride coated rigid steel conduit type for all exposed conduits indoors unless specifically called out for galvanized rigid steel on Contract Drawings or per locations specified in Section 16050.

2) Minimum Size: 3/4 inch.

3. Flexible conduit:

a. Use flexible conduit for final connections between rigid conduit and motors, vibrating equipment, instruments, control equipment or where required for equipment servicing for all outdoor and indoor locations:

b. Minimum size: 3/4 inch:

1) 1/2 inch as allowed by ENGINEER when required for connection to instruments, door switches.

c. Maximum length:

Conduit Trade Size	Flexible Conduit Length (in)
1/2	18
3/4	18
1	18
1-1/4	18
1-1/2	18
2	36
2-1/2	36
3	36
3-1/2	38
4	40

4. Concrete encased and embedded conduits:
   a. Type PVC Schedule 40 and GRS-PVC as specified below:
      1) Use Type GRS-PVC in underground and embedded installation as follows:
         a) Stub-up and risers to grade floor or equipment from nonmetallic conduits.
         b) Entering and exiting underground or embedded conduit runs a minimum 12 inches above and below grade or finished floor.
         c) For any and all bends where the total deflection is greater than 45 degrees.
   b. Minimum size:
      1) 2 inches in duct banks unless otherwise indicated on the Drawings. Conduit specific for site lighting may be 1 inch as indicated on the Drawings.
      2) 1 inch for in slab conduits unless otherwise indicated on the Drawings. Conduits specific for building lighting and receptacle circuits may be 3/4 inch minimum.
5. GRS-PVC:
   a. Use specifically manufactured or machined threading dies to manufacturer's specifications to accommodate the PVC jacket.
6. EMT: EMT is not allowed on this project
7. GRS:
   a. Conduit shall be cut square and reamed before threading.
8. PVC:
   a. Conduit terminations shall be via threaded adapters into threaded hubs on the junction boxes or conduit bodies.

b. Conduit terminations into boxes without threaded hubs shall utilize a threaded adapter and a flat neoprene washer on the outside of the box.

1) Use a locknut on the inside of the box to tighten the adapter to the box.

c. Route conduit to afford it the maximum physical protection.

1) If necessary, cover conduit to afford additional protection when it cannot be shielded by the structure or machinery frames.

a) Use Schedule 80 where exposed runs may be subject to physical damage.

E. Conduit joints and bends:

1. General:

a. Where conduit is exposed to the weather or in NEMA Type 4 or NEMA Type 4X locations, make joints liquid-tight.

b. Keep bends and offsets in conduit runs to an absolute minimum.

c. All bends shall be symmetrical.

d. The following conduit systems shall use large radius sweep elbows:

1) All conduits containing medium voltage cables.

e. Make field bends with a radius of not less than the requirements found in the NEC:

1) The minimum bending radius of the cable must be less than the radius of the conduit bend.

2) Make all field bends with power bending equipment or manual benders specifically intended for the purpose:

a) Make bends so that the conduit is not damaged and the internal diameter is not effectively reduced.

b) For the serving utilities, make bends to meet their requirements.

f. Replace all deformed, flattened, or kinked conduit.

2. Threaded conduit:

a. Cut threads on rigid metallic conduit with a standard conduit cutting die that provides a 3/4-inch per foot taper and to a length such that all bare metal exposed by the threading operation is completely covered by the couplings or fittings used. In addition, cut the lengths of the thread such that all joints become secure and wrench tight just preceding the point where the conduit ends would butt together in couplings or where conduit ends would butt into the ends or shoulders of other fittings.

b. Thoroughly ream conduit after threads have been cut to remove burrs.

c. Use bushings or conduit fittings at conduit terminations.

d. On exposed conduits, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing “Galvabar” or CRC “Zinc It.”

e. Coat conduit threads with an approved electrically conductive sealant and corrosion inhibitor that is not harmful to the conductor insulation:

1) Use KOPR-Shield as manufactured by T&B on threads of ferrous conduit.

2) Apply to the male threads and tighten joints securely.

3) Clean excess sealant from exposed threads after assembly.

f. Securely tighten all threaded connections.

g. Any exposed threaded surface must be cleaned and coated with a galvanizing solution so that all exposed surfaces have a galvanized protective coating.

3. PVC:

a. Use approved solvent-weld cement specifically manufactured for the purpose. Spray type cement is not allowed.

b. Apply heat for bends so that conduit does not distort or discolor. Use a spring mandrel as required to assure full inside diameter at all bends:

1) Utilize a heater specifically for PVC conduit as recommended by the conduit manufacturer.

F. Conduit sealing and drainage:

1. Conduit drainage and sealing other than required for hazardous and classified areas:

a. Provide sealing and drainage in vertical drops of long (in excess of 20 feet), exterior, above grade conduit runs at the points at which the conduit enter buildings, switchgear, control panels, lighting panelboards, and other similar enclosures.

b. Provide seal fittings with drains in vertical drops directly above grade for exterior, above grade conduit runs that are extended below grade.

c. Provide conduit seals with drains in areas of high humidity and rapidly changing temperatures:

1) Where portions of an interior raceway pass through walls, ceilings or floors that separate adjacent areas having widely different temperatures.

d. Provide conduit seals similar to O/Z Gedney (Type CSM) on all conduits between corrosive and non-corrosive areas.

e. Seal one end only of all underground conduits at highest point with O/Z Gedney sealing (non-hazardous) filling, or equal.

2. Install seals with drains at all control panels, junction boxes, pullboxes, low points of conduit, or any place where moisture may condense and accumulate:

   a. Provide Crouse-Hinds Type EYD or approved equal, where drains are required.

   b. Provide Crouse-Hinds Type EYS or approved equal, where drains are not required.

G. Conduit supports:

1. General:

   a. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications:

      1) As specified in Section 16070.

      2) Provide support materials consistent with the type of conduit being installed as specified in Section 16050.

   b. Support conduit at the intervals required by the NEC at a minimum.

   c. Perforated strap and plumbers tape are not acceptable for conduit supports.

2. Above suspended ceilings:

   a. Support conduit on or from the structure, do not support conduit from hanging wires or suspended ceiling grid.

3. Concealed conduit on wood:

   a. Use 2-hole galvanized steel straps screwed or nailed to the wood or hammer-driven stamped galvanized type supports having serrated or saw tooth edges on the driven portion and designed specifically for the size and type of conduit being supported. Drive these latter supports so that the conduit is tightly and rigidly supported. Replace any dented or damaged conduit.

4. In steel stud construction:

   a. Tie conduit at maximum 4-foot intervals with No. 16 gauge double annealed galvanized wire or conduit clips so that conduit cannot move from vibration or other causes.

5. Conduit on concrete or masonry:

   a. Use 1-hole malleable iron straps with metallic or plastic expansion anchors and screws or support from preset inserts.

   b. Use preset inserts in concrete when possible.

   c. Use pipe spacers (clamp backs) in wet locations.

   d. On plaster or stucco, use 1-hole malleable iron straps with toggle bolts.

6. Conduit on metal decking:

   a. Use 1-hole malleable iron straps with 1-inch long cadmium-plated Type A panhead sheet metal screws. Fully or partially hammer-driven screws are not acceptable.

7. Suspended conduit:

   a. Use malleable iron factory-made split-hinged pipe rings with threaded suspension rods sized for the weight to be carried (minimum 3/8-inch diameter), Kindorf, or equal.

   b. For grouped conduits, construct racks with threaded rods and tiered angle iron or preformed channel cross members. Clamp each conduit individually to a cross member. Where rods are more than 2 feet long, provide rigid sway bracing.

8. Supports at structural steel members:

   a. Use beam clamps.

   b. Drilling or welding may be used only as specified or with approval of the ENGINEER.

9. PVC conduit supports:

   a. Mount all conduit with hangers specifically designed for use with PVC to minimize the problems of bowing resulting from the expansion and contraction of conduit caused by varying temperatures:

      1) Hangers to be constructed of PVC incorporating serrated teeth to grip the conduit securely and yet allow for conduit movement due to thermal considerations:

      2) As manufactured by: Carlon E978D, E, F, G, H, and J.

10. GRS-PVC systems:

   a. Provide right angle beam clamps and U bolts specially formed and sized to snugly fit the outside diameter of the coated conduit. Provide "U" bolts with PVC encapsulated nuts that cover the exposed portions of the threads.

   b. Securely fasten exposed conduits with PVC-coated clamps or straps manufactured and supplied by the GRS-PVC conduit supplier.

H. Expansion or expansion/deflection fittings:

1. General:

   a. Align expansion coupling with the conduit run to prevent binding.

   b. Follow manufacturer’s instructions to set the piston opening.

   c. Install expansion fittings across concrete expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction.

   d. Furnish fittings of the same material as the conduit system.

2. For metallic conduit (GRC and GRS-PVC) provide expansion or expansion/deflection couplings, as appropriate, where:

   a. Install expansion fittings a minimum of every 200 feet in straight conduit runs.

3. For PVC provide expansion or expansion/deflection couplings, as appropriate, where length change due to temperature variation exceeds 2 inches:

   a. Rigidly fix the outer barrel of the expansion coupling so it cannot move.

   b. Mount the conduit connected to the piston loosely enough to allow the conduit to move as the temperature changes.

I. Empty conduits:

1. Provide 1/2 inch wide, polyester pull tape rated 1250 pounds tensile strength in each empty conduit more than 10 feet in length. Pull tape shall be printed with sequential footage. Pull tape to be installed in site underground spare conduits and all fiber conduits even with fiber optic cable, shall include detectable 22 AWG conductor. Pull tape shall be Neptco Muletape WP1250P or equal for empty conduits within buildings and Neptco Muletape DT1250P or equal site underground conduits, refer to Section 16133.

2. Seal ends of all conduit with approved, manufactured conduit seals, caps or plugs immediately after installation:

   a. Keep ends sealed until immediately before pulling conductors.

J. Provide materials for SMUD conduit runs per SMUD requirements. CONTRACTOR is responsible to coordinate with SMUD for material requirements, and all inspections.

K. Conduit allowances:

1. Equipment locations may vary slightly from the Drawings. Include an allowance for necessary conduit and fittings for motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of locations indicated on the Drawings.

2. Locations for pull boxes, manholes, and duct banks may vary slightly from the Drawings. Include all costs for necessary conductors, conduits, ductbank, and related materials to adjust locations up to 25 linear feet from locations indicated on the Drawings.

L. Miscellaneous:

1. Seal roof penetrations for raceways and other items that penetrate the roof in accordance with roofing manufacturer's instructions and as indicated on the Drawings.

2. Provide electrical unions at all points of union between ends of rigid conduit systems that cannot otherwise be coupled:

   a. Running threads and threadless couplings are not allowed.

3. Replace any conduit installed that the ENGINEER determines does not meet the requirements of this Specification.

M. Conduit Installation Table:

1. Provide conduit based on following Conduit Installation Table.

CONDUIT INSTALLATION TABLE

CONDUIT INSTALLATION	CONDUIT TYPE
Exposed Conduit (indoor & outdoor):	Polyvinyl chloride coated rigid steel conduit or Galvanized rigid steel conduit per Drawings and 16050.
Conduit within Concrete Slab:	Schedule 40 PVC conduit.
Underground Conduits:	Schedule 40 PVC conduit. Refer to Section 16133.
Underground Conduits in Earth:	Polyvinyl chloride coated rigid steel conduit.
Vertical or horizontal sweeps, risers, or stubs into underground boxes:	Polyvinyl chloride coated rigid steel conduit for entire sweep, underground runs 5' prior to riser or stub, and 6" above finished grade minimum. Conduit 6" above finished grade shall be installed as exposed conduit. Long sweeps for medium voltage conduits.
Bottom Entrance of Switchgear, Distribution Panel, MCC, & etc:	Polyvinyl chloride coated rigid steel conduit.
Side or Top Entrance of Switchgear, Distribution Panel, MCC, & etc:	Polyvinyl chloride coated rigid steel conduit or Galvanized rigid steel conduit per Drawings and16050.
SMUD Conduits:	Per SMUD specifications.
Motor Conduit Box to Rigid Wireway System:	Flexible liquid tight metal conduit.
Instrumentation to Rigid Wireway System:	Flexible liquid tight metal conduit.
Door Switch to Rigid Wireway System:	Flexible liquid tight metal conduit or armored cable.
Concrete Duct Bank to Handhole:	Polyvinyl chloride coated rigid steel conduit.
Equipment Subject to Vibration:	Flexible liquid tight metal conduit.
Notes: 1. Any conduit not covered in the above categories shall be polyvinyl chloride coated rigid steel conduit. 2. All underground PVC conduits shall be encased in red concrete. 3. “A” and “D”-type conduits per the Conduit and Wire Routing Schedule shall have GRS-PVC conduit installed the entire length of the conduit run.	

3.02 FIELD QUALITY CONTROL

A. Refer to Section 16050.

3.03 PROTECTION

A. Refer to Section 16050.

END OF SECTION

SECTION 16133

DUCT BANKS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Electrical underground duct banks.
2. Duct spacing and terminations.
3. Steel reinforcing of concrete.
4. Excavation and patching.
5. Coordination with other underground utilities.
6. Concrete.
7. Two sack cement slurry mix fill.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of sub-CONTRACTOR's, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are 'related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01725 - Protection of Existing Facilities.
   b. Section 16050 - Common Work Results for Electrical.
   c. Section 16075 - Electrical Identification.
   d. Section 16130 - Conduits.

1.02 REFERENCES

A. As specified in Section 16050.

B. API Recommended Practice.

C. IADC Drilling Manual.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Provide trenching, forming, rebar, spacers, conduit, concrete, backfill, and compaction necessary for the complete installation of the duct banks.

B. Provide two sack cement slurry mix filled duct banks for all low voltage conduits, instrumentation conduits, and fiber optic conduits installed below grade, on the site, or in contact with the earth, unless otherwise indicated on the Drawings.

C. Provide two sack cement slurry mix filled duct banks for all low voltage conduits, instrumentation conduits, and fiber optic conduits installed below grade to within 20 feet of pile supported structures; then transition to reinforced concrete ductbank prior to crossing structure footing.

D. Provide two sack cement slurry mix filled duct banks for all low voltage conduits, instrumentation conduits, and fiber optic conduits installed below grade to within 10 feet of structure installed on slab; then transition to reinforced concrete ductbank prior to crossing structure footing.

E. Provide duct banks for all SMUD conduits installed below grade, on the site, or in contact with the earth, per SMUD requirements.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. PVC conduit spacers.

2. Detectable underground marking tape

3. Pull tape (synonymous with pull line or pull rope).

4. Detectable pull tape (synonymous with detectable pull line or detectable pull rope).

C. Shop drawings:

1. Submit site plan drawings of duct banks including underground profiles indicating all underground utilities.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. All conduits shall be labeled. Refer to Section 16075.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

B. Field conditions and related requirements:

1. Underground water table may be near or above the location of new duct banks.

2. Include cost for necessary dewatering, and cleaning equipment to perform work in underground duct banks, pull boxes and manholes, before installation.

1.09 WARRANTY

A. As specified in Section 16050.

1.10 SYSTEM START-UP

A. As specified in Section 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Conduit spacers:

1. One of the following or equal:

a. Carlon Snap-Loc.

b. Cantex.

c. Osburn Associates, Inc.

B. Detectable underground marking tape:

1. One of the following or equal:

a. Blackburn Manufacturing Company.

b. Pro-Line Safety Products.

c. Panduit.

C. Pull tape (synonymous with pull line or pull rope):

1. One of the following or equal:

a. Neptco Muletape WP1250P.

D. Detectable pull tape (synonymous with detectable pull line or detectable pull rope):

1. Detectable pull tape shall be installed in all fiber conduits along with fiber cable and in all spare fiber conduits.

2. One of the following or equal:

a. Neptco Muletape DT1250P.

2.02 MATERIALS

A. Provide conduit as specified in Section 16130:

1. Use duct suitable for use with 90-degree Celsius rated conductors.

2.03 MANUFACTURED UNITS

A. Conduit spacers:

1. Provide conduit spacers recommended by the conduit manufacturer or specified above.

2. Saddle type.

3. Non-metallic, non-corrosive, non-conductive.

4. Interlocking type:

   a. Vertical interlocking.

   b. Horizontal interlocking.

5. Suitable for concrete encasement.

6. Molded-in rebar holder.

7. Accommodates 2-inch through 6-inch conduit sizes.

8. Relieves the conduit from both horizontal and vertical stresses.

B. Detectable marking tape:

1. Provide a detectable tape, locatable by a cable or metal detector from above the undisturbed grade.

2. Aluminum core laminated between polyethylene film.

3. Six-inch wide red tape imprinted with black lettering "CAUTION - BURIED ELECTRIC UTILITIES."

C. Pull tape (synonymous with pull line or pull rope):

1. Minimum 1/2-inch wide, flat design.

2. Polyester.

3. Minimum pulling strength 1,250 pounds.

4. Sequential footage markings.

D. Detectable pull tape (synonymous with detectable pull line or detectable pull rope):

1. Minimum 1/2-inch wide, flat design.

2. Polyester.

3. Minimum pulling strength 1,250 pounds.

4. Sequential footage markings.

5. No. 22 AWG detectable conductor.

2.04 MIXES

A. Provide a red-oxide conduit encasement coloring agent Coral red “Fhromix C-22” as manufactured by L.M. Scofield Company or equal. For red color for both concrete ductbanks and two sack cement slurry mix fill ductbanks. Color additive to be mixed using the quantity recommended by the manufacturer for the class of concrete required per installation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Duct banks:

1. Install two sack cement slurry mix filled duct banks for low voltage conduits at least 30 inches below finish grade to top of conduit, unless otherwise indicated on the Drawings.

2. If minimum cover cannot be obtained, provide 4 inch concrete cap over ductbank. Installation with insufficient cover and concrete cap must be approved by ENGINEER prior to placement of conduits.

3. Damage minimization:

   a. Conduit should not be left exposed in an open trench longer than is necessary.

   b. Protect all underground duct banks against damage during pouring of concrete or backfilling.

4. All plastic conduit fittings to be joined should be exposed to the same temperature conditions for a reasonable length of time before assembly.

5. Provide No. 4/0 American Wire Gauge bare copper ground wire the entire length of reinforced concrete duct bank and bond to the grounding system as indicated on the Drawings.

6. Install underground ducts to be self-draining:

   a. Slope duct banks away from buildings to manholes and handholes.

   b. Slope duct banks uniformly from manholes to manholes or both ways from high points between manholes.

   c. Slope a minimum of 1/4 inch per 10 feet

7. Where new duct banks join to existing manholes and handholes make the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions.

8. Install spare conduits as noted on Drawings:

   a. Provide pull tape in all spare conduits.

   b. Cap spare conduits at each end with appropriate caps.

9. Install duct seal within all conduits inside a structure or buildings where the conduit is routed from outside structure or building.

10. Install duct seal within all conduits at pull boxes, manholes, handholes for conduits that are routed inside structure or building.

C. Trenching:

1. Trench must be uniformly graded with the bottom, rock free and covered with select material.

2. Whenever possible, use the walls of the trench as forms for concrete encasement:

   a. Forms are required where the soil is not self-supporting.

3. Avoid damaging existing ducts, conduits, cables, and other utilities.

D. Duct spacing:

1. Separate conduits with manufactured plastic spacers using a minimum space between the outside surfaces of adjacent conduits of 2 inches:

    a. Separate medium voltage ducts a minimum of 7.5 inches on center.

2. Install spacers to maintain uniform spacing of duct assembly a minimum of 4 inches above the bottom of the trench during concrete pour. Install spacers on 8-foot maximum intervals:

    a. Due to some distortion of conduit from heat, and other means, it may be necessary to install extra spacers within the duct bank:

        1) Install the intermediate set of spacers within normal required spacing to maintain the proper horizontal clearance:

            a) Clearance is required to allow the proper amount of concrete to infiltrate vertically among the duct to ensure proper protection.

3. Spacers shall not be located at the center of a bend:

    a. Locate spacer in the tangent, free of the coupling on fabricated bends.

    b. Locate spacers midway between the tangent and the center bend on trench formed sweeps.

E. Terminating:

1. Use bell ends in duct at entrances into manholes.

2. Make conduit entrances into manholes tangential to walls.

3. Form trapezoidal transitions between duct bank and cable manholes as needed in order to ensure adequate cable bending radius for the duct bank-to-manholes transition.

4. New manhole applications, provide a single opening or “window” per duct bank, sized to accommodate the duct bank envelope.

5. Stub up PCS conduit elbow and extensions as required within handholes per detail on Contract Drawings.

F. Concrete:

1. Provide nonferrous tie wires to prevent displacement of the conduits during pouring of concrete:

    a. Tie wire shall not act as a substitute for spacers.

2. Install minimum 3-inch cover around conduit and rebar per Detail EM001.

3. Consolidation of encasement concrete around duct banks shall be by hand pudding, with no mechanical vibration.

4. Conduit is subject to temperature rise. As concrete cures, allow the free end to expand by pouring the concrete from the center of the run or from one tie in point.

G. Two Sack Cement Slurry Mix Fill:

1. Install two sack cement slurry mix fill colored red.

2. Two sack cement slurry mix material shall be placed in the trenches to be backfilled to provide cover and conduit envelop.

3. Provide nonferrous tie wires to prevent displacement of the conduits during pouring of slurry.

H. Marking tape:

1. Install a detectable marking tape 12 inches above the duct bank the entire length of the duct bank. Provide separate run of detectable marking tape for every 10” of trench wide.

I. Pull tape:

1. Install pull tape in all spare conduits.

2. Install detectable pull tape in all fiber conduits, both spare fiber conduits and conduits with fiber cables installed.

J. Provide ductbanks for SMUD conduits per SMUD requirements. CONTRACTOR is responsible to coordinate with SMUD for trenching and backfill requirements, and all inspections.

K. Ductbank allowances:

1. Locations for pull boxes, manholes, and duct banks may vary from the Drawings. Include all costs for necessary conductors, conduits, ductbank, and related materials to adjust locations up to 25 linear feet from locations indicated on the Drawings.

L. Restore all surfaces to their original condition as specified in Section 01725, unless otherwise specified.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

3.03 CLEANING

A. Clean conduits of dirt and debris by use of an appropriately sized steel mandrel no less than 1/2 inch smaller than the inside diameter of the conduit.

3.04 PROTECTION

A. As specified in Section 16050.

B. Provide shoring and pumping to protect the excavation and safety of workers.

C. Protect excavations with barricades as required by applicable safety regulations.

END OF SECTION

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SECTION 16134

BOXES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Device boxes.
2. Raceway system boxes.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. As specified in Section 16050.

B. American National Standards Institute (ANSI).

C. ASTM International (ASTM):

1. A 47 - Standard Specification for Ferritic Malleable Iron Castings.
2. D 149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. D 495 - Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.
4. D 570 - Standard Test Method for Water Absorption of Plastics.
5. D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
6. D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

7. D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

D. Joint Industry Conference (JIC).

E. National Electrical Code (NEC).

F. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

G. Underwriters Laboratories, Inc. (UL):

1. 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions:

1. Arcing parts: Circuit breakers, motor controllers, switches, fuses, or any device intended to interrupt current during its operation.

2. Raceway system boxes: Boxes that are used for wire and cable pullboxes, conduit junction boxes, or terminal boxes.

1.04 SYSTEM DESCRIPTION

A. Provide outlet boxes for devices such as switches, receptacles, telephone VOIP, computer data jacks, SCADA jacks, security systems, fire systems, junction, and pullboxes for use in the raceway systems, etc.

B. Provide boxes and conduit bodies as indicated on the Drawings or as needed to complete the raceway installation.

C. Provide nameplates on all junction boxes and junction terminal boxes.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Manufacturer.

2. Materials.

3. Dimensions:

a. Height.

b. Width.

c. Depth.

d. Weight.

e. NEMA rating.

4. Conduit entry locations.

5. Catalog cut sheets.

6. Installation instructions.

C. Shop drawings:

1. Include identification and sizes of pull boxes.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. All boxes to include nameplate. Where a box does not have a tag shown on the Contract Drawings, the CONTRACTOR shall propose a tag and submit to ENGINEER for approval.

C. Regulatory requirements:

1. Outlet boxes shall comply with all applicable standards of:

a. JIC.

b. NEC.

c. NEMA.

d. UL.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SEQUENCING

A. As specified in Section 16050.

1.10 WARRANTY

A. As specified in Section 16050.

1.11 SYSTEM START-UP

A. As specified in Section 16050.

B. All junction boxes and junction terminal boxes to be labeled prior to General Start-Up and Testing Procedures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Pressed steel boxes:

a. Steel City.

b. Appleton.

c. Crouse - Hinds.

d. Thomas & Betts.

2. Plastic and/or fiberglass boxes:
   a. Hoffman.
   b. Carlon.
   c. Stahlin.
3. Plastic coated steel boxes:
   a. Rob Roy.
   b. OCAL.
4. Cast device boxes:
   a. Appleton.
   b. Crouse - Hinds.
   c. OZ/Gedney.
5. Floor outlet boxes with 1-inch conduit knockouts:
   a. Steel City, 640 Series.
   b. Hubbell type B25 with S2530 coverplate.
6. Floor outlet boxes in open areas:
   a. Hubbell SC-3098 with plate SS-309-D for power.
   b. Hubbell SC-3098 with plate SS-309-T for telephone.
7. In-use weatherproof metallic GFI outlet box and cover:
   a. Carlon.
   b. TayMac.
8. Formed steel enclosures:
   a. Hoffman.
   b. Thomas and Betts.
   c. Stahlin.
   d. Ritta.
9. Stainless steel enclosures:
   a. Hoffman.
   b. Stahlin.
   c. Rittal.
10. Pressed steel boxes and concrete boxes:
    a. Appleton.
    b. Steel City.
    c. Cooper/Crouse Hinds.
    d. OZ Gedney.

2.02 MANUFACTURED UNITS

A. Pressed steel boxes:

1. One-piece galvanized pressed steel.
2. Knockout type boxes.
3. Minimum size 4-inch square by 2-1/8-inch deep.

B. Concrete rated boxes:

1. For outlets and pull boxes in concrete construction.
2. Pressed steel or cast construction, concrete tight.
3. Knockout sizes range from 1/2 inch to 1 inch.
4. Depth as needed.
5. Types:
   a. Four-inch octagon.
   b. Four-inch octagon ceiling boxes with hanging bars.
   c. Gangable masonry boxes:
      1) 3-1/2-inch deep, 3-3/4-inch high, length as required:
         a) 2-1/2-inch deep boxes may be used where wall thickness precludes the use of the deeper boxes.
      2) With partitions as needed.

C. Threaded-hub boxes:

1. Construction:
   a. With internal green ground screw.
   b. Furnished with a suitable gasketed cover.
   c. With integral cast mounting lugs when surface mounted.
   d. Conduit sizes range from 3/4 inch to 1 inch.
   e. Tapered threaded hubs with integral bushing.
2. Malleable iron boxes:
   a. Conforming to ASTM A 47 Grade 32510.

D. Polyvinyl chloride coated threaded-hub boxes:

1. Construction:
   a. With internal green ground screw.
   b. Furnished with a suitable gasketed cover.
   c. With integral cast mounting lugs when surface mounted.
   d. Conduit sizes range from 3/4 inch to 1 inch.
   e. Double coated with a nominal 0.002-inch (2 mil) urethane on both the interior and exterior before application of PVC coating.

f. With a minimum 0.040-inch (40 mil) PVC coating bonded to exterior.

g. With pressure sealing sleeve to protect the connection with conduit.

E. Fiberglass boxes:

1. NEMA Type 4X.

2. Fiberglass boxes to be used to house flow transmitters installed above grade outdoors. Provide enclosures with backpanel to mount flow transmitter. Size box to allow for sufficient access around flow transmitter, minimum 6” on all four sides.

3. Constructed of molded fiberglass reinforced polyester.

4. Integral neoprene gasket on cover attached with an oil-resistant adhesive.

5. Enclosures to have internal pads for mounting optional panels and terminal kits.

6. Covers:

a. Screw cover enclosures:

1) Covers held in place with captive, stainless steel, or monel screws.

2) Covers attached to body with internal zinc-plated steel hinges.

b. Quick release latches covers:

1) Corrosion resistant fiberglass hinges.

2) Spring loaded fiberglass latches with a monel or stainless steel bail attached with monel or stainless steel screws.

3) With a Type 316 stainless steel padlock hasp.

7. With external mounting feet.

8. Meeting the following minimum standards and tests:

Physical Property	Value	ASTM Method
Flexural strength	12,000 psi	D 790
Heat distortion	400° Fahrenheit	D 648
Water absorption (24 hrs)	0.5 percent	D 570
Tensile strength	5000 psi	D 651
Specific gravity	1.8	D 792
Flammability	94V-0	UL 94
Dielectric strength	4000 V.P.M.	D 149
Arc resistance	180 second	D 495

F. Formed steel enclosures:

1. Steel:

   a. NEMA Type 12 or NEMA 4 as required per Drawings and Section 16050.

   b. Fabricated from 14-gauge steel, minimum.

   c. All seams continuously welded ground smooth.

   d. Hinged door.

   e. Provide with backpanel and terminal blocks if required.

   f. Provide large enclosures with door and body stiffeners for extra rigidity.

   g. No holes or knockouts.

   h. Finish:

      1) ANSI-61 gray electrostatically applied polyester powder inside and out over cleaned and primed surfaces.

      2) White electrostatically applied polyester powder mounting plate.

   i. Heavy gauge steel external mounting brackets when surface mounted.

2. Stainless steel:

   a. NEMA Type 4X:

   b. Fabricated from 14-gauge Type 316 stainless steel.

   c. All seams continuously welded.

   d. Hinged door.

   e. Provide with backpanel and terminal blocks if required.

   f. Provide large enclosures with door and body stiffeners for extra rigidity.

   g. No holes or knockouts.

   h. Finish:

      1) Brushed.

   i. Stainless steel external mounting brackets when surface mounted.

G. Cast iron junction boxes:

1. NEMA Type 4.

2. Recessed cover boxes.

3. Suitable for use outdoors where subject to rain, dripping, or splashing water.

4. Designed for flush mounting in walls or floors:

   a. Can be surface mounted using mounting lugs.

5. Construction:

a. Cast iron box.

b. Covers:

1) Checkered plate covers suitable for foot traffic.

2) When used in areas subject to vehicular traffic H-20 loading.

c. Hot dip galvanized.

d. Neoprene gasket.

e. Stainless steel screw covers.

H. Explosion proof Boxes:

1. Boxes shall be rated for Class 1, Division 1 or 2 and weatherproof locations.

I. Weatherproof switch, outlet and receptacle box

1. Shall be fitted with cast aluminum gasketed cover (weather box) rated for wet locations. Each receptacle access cover shall have a gasketed spring door to maintain the weatherproof integrity with plug inserted in accordance with NEC 406.9 for unattended locations. Final decision of type of access cover for specific location shall be per Engineer. Screws and hinge springs shall be 316 stainless steel.

2.03 ACCESSORIES

A. Fasteners:

1. Electroplated or stainless steel in boxes with wiring devices.

2. Screws, nuts, bolts, and other threaded fasteners:

a. Stainless steel.

B. Provide breather and drain fittings where appropriate.

C. Internal panels:

1. Provide internal panels where required for mounting of terminal strips or other equipment

2. With plated steel shoulder studs.

3. Steel with white polyester powder finish.

D. Floor stand kit when shown:

1. Fabricated from 12-gauge steel.

2. Bottom plate 11 gauge.

3. Heights:

a. 12 inches, or as required so top of panel does not exceed 72 inches from floor.

4. Do not provide external mounting brackets, when a floor stand kit is used.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. General:

1. Provide materials and construction suitable for environmental conditions at the location of the box as specified in Section 16050.

2. Provide outlet box materials to match the conduit system:

   a. GRC - Cast ferrous boxes.

   b. PCS - Polyvinyl chloride coated cast ferrous boxes.

   c. PVC - PVC boxes.

3. Solid type gang boxes:

   a. For more than 2 devices.

   b. For barriered outlets.

4. Support all wall mounted NEMA Type 4 or NEMA Type 4X boxes to maintain a minimum of 7/8-inch free air space between the back of the enclosure and the wall:

   a. Use machined spacers to maintain air space; built-up washers are not acceptable.

   b. Use stainless steel or nylon materials for spacers.

5. Use cast malleable iron boxes when box must support other devices.

6. Boxes serving luminaires or devices:

   a. Use as pull boxes wherever possible.

7. Fit all cast boxes and pressed steel boxes for flush mounting in concrete with cast, malleable box covers and gaskets.

8. In terminal boxes, furnish terminals as indicated on the Drawings, with a minimum of 25 percent spare terminals:

   a. Furnish wireways for discrete and analog/DC wiring.

   b. Separate analog wiring from 120 V discrete or power wiring.

9. Size boxes in accordance with NEC requirements and to provide sufficient room for the future components and cables indicated on the Drawings.

10. For fire-rated construction, provide materials and installation for use in accordance with the listing requirements of the classified construction.

C. Outlet boxes:

1. Locate outlet boxes as indicated on the Drawings:

   a. Adjust locations so as not to conflict with structural requirements or other trades.

2. Use deep threaded-hub malleable iron boxes:
    a. In hazardous areas.
    b. Where exposed to the weather.
    c. In unheated areas.
    d. Where subject to mechanical damage:
        1) Defined as exposed boxes less than 10 feet above the floor.
    e. To act as a pull box for conductors in a conduit system.
    f. Accommodate wiring devices.
3. Use deep threaded-hub plastic coated malleable iron boxes in corrosive and NEMA Type 4X area and when the conduit system is PVC coated steel.
4. Outlet boxes may be used as junction boxes wherever possible.

D. Pull boxes and junction boxes:
1. Size pull boxes in accordance with NEC requirements and to provide sufficient room for any future conduits and cables as indicated on the Drawings.
2. Install pull boxes such that access to them is not restricted.

E. For boxes not indicated:
1. Provide types and mountings as required to suit the equipment and that will be consistent with the conduit system and environmental conditions as indicated in Section 16050.
2. Outlet, switch, and junction boxes for flush-mounting in general purpose locations:
    a. One-piece, galvanized, pressed steel.
3. Ceiling boxes for flush mounting in concrete:
    a. Deep, galvanized, pressed steel.
4. Outlet, switch, and junction boxes where surface mounted in exposed locations:
    a. Cast ferrous boxes with mounting lugs, zinc or cadmium plating finish.
5. Outlet, control station, and junction boxes for installation in corrosive locations:
    a. Fiberglass reinforced polyester, stainless steel, or plastic coated steel to match the conduit system.
    b. Furnished with mounting lugs.
6. Boxes for concealed conduit system:
    a. Non-fire rated construction:
        1) Depth: To suit job conditions and comply with the NEC.
        2) For luminaries: Use outlet boxes designed for the purpose:

a) 50 pounds or less: Box marked “For Fixture Support.”

b) More than 50 pounds: Box listed and marked with the weight of the fixture to be supported (or support luminaire independent of the box.)

3) For junction and pull boxes: Use galvanized steel boxes with flush covers.

4) For switches, receptacles, etc:

a) Plaster or cast-in-place concrete walls: Use 4-inch or
4-11/16-inch galvanized steel boxes with device covers.

b) Walls other than plaster or cast-in-place concrete: Use type of galvanized steel box which will allow wall plate to cover the opening made for the installation of the box.

7. Recessed boxes in fire rated (2 hours maximum) bearing and nonbearing wood or steel stud walls (gypsum wallboard facings):

a. Use listed single and double gang metallic outlet and switch boxes.

1) The surface area of individual outlet or switch boxes shall not exceed 16 square inches.

b. The aggregate surface area of the boxes shall not exceed 100 square inches per 100 square feet of wall surface.

c. Securely fasten boxes to the studs.

1) Verify that the opening in the wallboard facing is cut so that the clearance between the box and the wallboard does not exceed 1/8 inch.

d. Separate boxes located on opposite sides of walls or partitions by a minimum horizontal distance of 24 inches.

1) This minimum separation distance may be reduced when wall opening protective materials are installed according to the requirements of their classification.

e. Use wall opening protective material in conjunction with boxes installed on opposite sides of walls or partitions of staggered stud construction in accordance with the classification requirements for the protective material.

8. Other fire rated construction: Use materials and methods to comply with the listing requirements for the classified construction.

F. Recessed boxes:

1. Support recessed boxes in suspended ceilings or stud partitions with galvanized steel box hangers of types made specifically for the purpose or attach directly to wood members or blocking.

2. Secure hangers or boxes to wood with 1-inch long cadmium-plated Type A pan head screws:

a. Fully or partially hammer-driven screws are not acceptable.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

3.03 CLEANING

A. As specified in Section 16050.

3.04 PROTECTION

A. As specified in Section 16050.

END OF SECTION

SECTION 16136

WIREWAY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Wireway systems as indicated on the Drawings or as required for a complete conduit and wiring system. Wireways not shown on Drawings shall be approved by ENGINEER.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. Refer to Section 16050.

B. Underwriter's Laboratories (UL):

1. Article 870 - Wireways, Auxiliary Gutters, and Associated Fittings.

C. National Electrical Manufacturers Association (NEMA):

1. ICS-6 - Industrial Control Systems - Enclosures.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. System includes horizontal and/or vertical straight runs of wireway, fittings, covers, splices, barriers, and related accessory and supports:

1. Connected to form a complete system.

B. Provide separate wireways or means of separation between low voltage wires (120 V, 480 V) and instrumentation (4-20 mA, communication networks), control wires

(24VDC) for wireway installed at Electrical Room of Area 42 Flocculation/Sedimentation Basins 3 and 4.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 16050.

B. Product Data:

1. Technical Information:

a. Catalog cut sheets.

b. Wireway construction and materials.

c. Maximum loading and span.

d. NEMA enclosure type.

2. Dimensions:

a. Width.

b. Depth.

3. Weight of wireway sections and fittings.

4. Complete bill of materials.

5. Manufacturer's installation instructions.

C. Shop Drawings:

1. Provide complete details and scaled drawings for the layout of the installed wireway system showing all components and proposed mounting details.

D. Calculations:

1. Provide calculations to confirm compliance with the NEC with respect to cross sectional area and fill requirements based on actual fill, unless Contract Drawings call for larger wireway.

2. Provide structural calculations to ensure that the installed system meets all structural, seismic per Section 16050, wind per Section 16050 requirements at the project site with respect to support and mounting:

a. Stamped by a Professional Engineer registered in the State where the project is being constructed.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Manufacturer Qualifications:

1. Member of NEMA for the manufacturer of wireway systems and fittings of types and capacities required.

C. Wireway shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. Refer to Section 16050.

1.09 SEQUENCING

A. The Drawings indicate the general route of the wireway systems. Data presented on those drawings are as accurate as preliminary surveys and planning can determine until final equipment selection is made.

B. Specifications and Drawings are for assistance and guidance but exact routing, locations, distances, and levels will be governed by actual field conditions. Make field surveys as part of the work before ordering material.

1.10 WARRANTY

A. Refer to Section 16050.

1.11 SYSTEM STARTUP

A. Refer to Section 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Metallic Wireway:

1. One of the following or equal:

a. B-Line.

b. Hoffman.

c. Hammond.

d. Rittal Electromate.

B. Non-metallic wireway:

1. One of the following or equal:

a. Hoffman.

b. Carlon.

2.02 EQUIPMENT

A. Provide wireways as indicated on the Drawings or approved by ENGINEER with respect to:

1. Type (lay-in or feed-through or trough).

2. Dimensions.

3. NEMA enclosure rating, per Section 16050 requirements.

4. Wireway material.

B. Wireways to have continuous hinged covers with hasp closures.

2.03 COMPONENTS

A. Fittings:

1. Elbows, tees, and crossings:

a. Of the same materials and construction as the straight runs.

2. Expansion Fittings:

a. Provide flexible or sliding fittings.

B. Covers:

1. Hinged on one side.

C. Gaskets:

1. As required to meet NEMA enclosure requirements:

a. Provide gaskets at each flange and door opening to assure complete seal between wireway components.

b. Held in place with adhesive or formed in place.

2.04 ACCESSORIES

A. Barriers:

1. To separate power, control and instrument wiring running within the same wireway.

2. Same material and manufacturer as the wireway.

B. Mounting Hardware:

1. Refer to Section 16050.

2.05 SOURCE QUALITY CONTROL

A. Manufactured in compliance with NEMA ICS-6.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify all dimensions and route before ordering wireway:

1. Make all necessary field measurements.

2. Coordinate with all subcontractors and suppliers to determine structural dimensions and equipment dimensions to avoid all potential conflicts with other systems.

3.02 INSTALLATION

A. Refer to Section 16050.

B. Install the wireway per the manufacturer's guidelines and submitted installation instructions to meet the seismic and wind requirements at the project site.

C. Ground all conduits within wireways with insulated throat grounded bushings and jumper all grounding bushings together with #12 ground wire connected to ground grid conductor.

D. General:

1. Install in straight runs as much as possible, minimizing the number of turns.

2. Expansion Fittings:

   a. Install as recommended by the manufacturer to accommodate thermal expansion.

   b. Install where wireway crosses structural expansion joints.

3. Fittings:

   a. Not all fittings are indicated on the Drawings:

      1) Provide all fittings required to suit the installation.

4. Wireway Supports:

   a. Support wireway in accordance with manufacturer's instructions and as required by the seismic conditions.

   b. Support bracket spacing shall meet the requirements of the wireway manufacturer, and NEC.

   c. Provide wireway supports with channels under the entire width of wireway.

   d. Secure wireway to supports with manufacturer-approved fittings.

5. Mounting:

   a. Oriented to allow hinged doors to be opened minimum 90 degrees.

   b. Oriented to allow safe access to doors for maintenance and future installations.

6. Wiring Installation:

   a. In accordance the NEC.

   b. Begin wiring installation only after the complete raceway system is installed.

   c. Verify that all wireway surfaces and accessories are smooth, free from burrs or sharp edges.

   d. Only install wiring that are UL listed for wireway use.

7. Wall Penetrations:

   a. Terminate wireway on both sides of penetration, and penetrate wall via conduits:

      1) Seal all open spaces inside and around conduits where they penetrate building exterior walls or fire-rated walls.

      2) Fill spare conduits with sealing compound.

3) Provide sealing material in accordance with all applicable codes and regulations.

3.03 FIELD QUALITY CONTROL

A. Refer to Section 16050.

B. Inspect entire wireway system for the following:

1. Secure anchoring.
2. Proper supports.
3. Burrs or sharp edges.
4. Sufficient clearance from ducts and piping, especially hot pipes.

3.04 CLEANING

A. Refer to Section 16050.

3.05 PROTECTION

A. Refer to Section 16050.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Switches.
2. Receptacles.
3. Plates.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 16050 - Common Work Results for Electrical.
   c. Section 16134 - Boxes.

1.02 REFERENCES

A. As specified in Section 16050.

B. Underwriters Laboratories Inc. (UL):

1. 20 - General Use Snap Switches.
2. 498 - Standard for Attachment Plugs and Receptacles.
3. 514D - Cover Plates for Flush-Mounted Wiring Devices.
4. 943 - Ground-Fault Circuit-Interrupters.
5. 1472 - Solid State Dimming Controls.

C. National Electrical Manufacturers Association (NEMA):

1. WD1 - General Color Requirements for Wiring Devices.
2. ICS 5 - Industrial Control and Systems, Control Circuit and Pilot Devices.
3. OS1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
4. WD6 - Wiring Devices Dimensional Specifications.

D. Federal Specification:

1. W-C 596.

2. W-S 896.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions:

1. GFCI: Ground fault circuit interrupter.

2. P-S: Pass and Seymour.

3. CWD: Cooper Wiring Devices.

4. T&B: Thomas and Betts.

1.04 SYSTEM DESCRIPTION

A. Switches, receptacles, and plates as indicated on the Drawings wired and operable to form a complete system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Catalog cut sheets.

C. Shop drawings:

1. Engraving schedule:

a. Furnish complete engraving schedule for engraved nameplates.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Wiring devices shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. Refer to Section 16050.

1.09 WARRANTY

A. Refer to Section 16050.

1.10 SYSTEM STARTUP

A. As specified in Section 16050.

B. All switches, receptacles and jacks to be labeled prior to General Start-Up and Testing Procedures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Switches:

1. General purpose toggle switches, one of the following or equal:

   a. Part numbers are for brown switches:

	1-pole	2-pole	3-way	4-way
Hubbell	HBL 1221	HBL 1222	HBL 1223	HBL 1224
Leviton	1221-2	1222-2	1223-2	1224-2
CWD	4901	4902	4903	4904

2. Switches for NEMA Type 4 and NEMA Type 4X locations, one of the following or equal:

	1-pole	2-pole	3-way	4-way
Hubbell	HBL 1281	HBL 1282	HBL 1283	HBL 1284
Cooper Wiring Devices	2291	2292	2293	2294

3. Switches for office areas, one of the following or equal:

	1-pole	2-pole	3-way	4-way
Hubbell	HBL 2121I	HBL 2122I	HBL 2123I	HBL 2124I
CWD	5621-2	5622-2	5623-2	5624-2

4. Switches for photocells, one of the following or equal:

	Single-pole, double-throw
Hubbell	HBL 1385
CWD	2226

5. Occupancy Sensor Switches:

   a. For non-networked lighting control systems.

   b. WattStopper DW-100-I for two-way switching applications.

   c. WattStopper DW-103-I for multi-way switching applications.

6. Dimmer switches:

   a. For non-networked lighting control systems.

   b. Rectangular design with LED light level indicators:

      1) Lutron MAESTRO™ MA-1000 controller for incandescent light.

      2) Lutron MAESTRO™ MALV-1000 controller for magnetic low-voltage lights.

      3) Lutron MAESTRO™ MA-R remote for additional control stations.

B. Receptacles:

1. General purpose receptacles, one of the following or equal:

	Single	Duplex	GFCI	Weather Resistant GFCI
Hubbell	HBL5361	HBL5362	GF5362A	GFR5362SG
Leviton	5361	5362	7899	W7899-W
CWD	5361B	5362B	HGF20B	WRVGF20W

a. Part numbers are for brown receptacles.

2. 250 VAC receptacles, one of the following or equal:

a. Hubbell: HBL5462.

b. Cooper wiring devices: 5462B.

3. 480-Volt, 3-phase receptacles:

a. 30 ampere:

1) Crouse-Hinds ARE3423.

2) Hubbell Hubbellock® 21420.

3) Russellstol™ DF3404FRAB.

b. 60 ampere:

1) Crouse-Hinds AREA6425.

2) Hubbell Hubbellock® 26410 or 26420 with 26401 box and 26404 adapter.

3) Russellstol™ DF6404FRAB.

C. Plates:

1. General location, one of the following or equal:

a. Provide plates with number of gangs as required:

	Switches	Office Switches	Standard Duplex Receptacles	GFCI Receptacles
P-S	SS1-N	SS26	SS8	WPH26

2. Wet or corrosive areas, one of the following or equal:

	Switches	Outdoor Receptacles	Indoor Duplex Receptacles	Corrosive Locations
Hubbell	1750			
T&B	CCT	CKMU		
P-S	CAI-GL		CA8-GH	3780-SC

2.02 MANUFACTURED UNITS

A. Switches:

1. General:

a. For non-networked lighting control systems. Networked lighting control systems are specified in Section 16500.

b. 120-277 VAC.

c. 20 ampere.

d. Specification grade.

e. Back and side wired unless otherwise indicated.

f. Integral grounding terminal.

g. Totally enclosed:

1) Color-coded body with color corresponding to ampere rating.

h. Provide switches with the operator style and contact arrangement as indicated on the Drawings and as required for proper operation.

i. Color:

1) Ivory in finished areas.

2) Brown in all other areas.

2. General purpose switches:

a. Toggle type.

3. Corrosive and wet areas requiring NEMA Type 4 or NEMA Type 4X enclosures:

a. Pushbutton switch

4. Switches for office areas:

a. Rocker type.

b. Rectangular.

5. Switches for use with photocell:

a. Maintained contact.

b. Two circuit.

c. Three position:

1) Center off.

6. Occupancy sensor switches:

a. Wall switch with dual-technology passive infrared and ultrasonic sensor.

1) Configured such that lights turn on only when both infrared and ultrasonic sensors detect activity, but do not turn off as long as either sensor detects activity.

b. Selectable “automatic-on” mode activated by sensors or “manual-on” mode activated by pushbutton.

c. Adjustable 5-30 minute time delay.

d. Rated for fluorescent lighting loads of up to 800W.

e. True multi-way switching allowing identical controls at any location for multi-way switching applications.

7. Dimmer switches shall be rectangular design with LED light level indicators:

a. Lutron MAESTRO™ MA-1000 controller for incandescent light.

b. Lutron MAESTRO™ MALV-1000 controller for magnetic low-voltage lights.

c. Lutron MAESTRO™ MA-R remote for additional control stations.

B. Receptacles:

1. General purpose receptacles:

a. Single or duplex as indicated on the Drawings.

b. 125 VAC.

c. 20 ampere or as indicated on the Drawings.

d. NEMA Type 5-20R configuration for 20 ampere receptacles.

e. Other NEMA configurations as indicated on the Drawings.

f. Specification grade.

g. Back wired.

h. One-piece mounting strap.

i. Color:

1) Ivory in finished areas.

2) Brown in all other areas.

3) Orange when powered by a UPS.

2. Ground fault interrupter receptacles (GFCI):

a. 125 VAC.

b. 20 ampere.

c. Trip level 4-6 milliampere.

d. Individual and feed through protection.

e. UL 943 and UL 498 listed.

f. NEMA Type 5-20R configuration.

g. For damp or wet locations:

1) Weather resistant, in accordance with UL 498.

3. 250 VAC receptacles:

a. 2-pole, 3-wire grounding for 240 VAC circuits.

b. 3-pole, 4-wire grounding for 208 VAC 3-phase circuits.

c. Ampere rating as indicated on the Drawings.

d. Provide NEMA configuration as required by the equipment connected to the outlet.

4. 480 VAC receptacles:

a. 3-pole, 4-wire grounding.

b. Ampere rating as indicated on the Drawings.

c. Spring door on receptacle.

d. Furnish one matching plug for each 480-volt power receptacle.

C. Plates:

1. General location:

a. Type 302 or 304 stainless steel.

b. Brushed satin finish.

c. Minimum thickness: 0.032 inches.

d. Rectangular or square shape.

e. Engraving:

1) Engrave each plate with the following information:

a) Area served.

b) Light switches shall also be provided with a separate engraved phenolic nameplate to identify use (i.e. “OUTSIDE BUILDING LIGHTS”, “PERIMETER LIGHTS”, “MCC ROOM”, etc.)

c) Panelboard and Circuit number.

2) Treat engraving to improve visibility and, except for stainless steel plates, to prevent corrosion.

3) Characters shall be block letter pantograph engraved with a minimum character height of 1/8-inch.

f. Coordinate the number of gangs, number and type of openings with the specific location.

2. Outdoor and wet areas:

a. General:

1) UL listed for wet locations.

2) Gasketed.

3) Die cast metal:

a) Match material to box material.

b. Switches:

1) Lever operated.

c. Receptacles:

1) Weather proof in-use cover per Section 16134 - Boxes.

2) Lockable.

3. Corrosive areas provide all materials rated for NEMA 4X:

a. Neoprene.

b. Gasketed.

c. Weatherproof.

D. Data and communications jacks:

1. General:

a. Admin Network Data jacks to be blue, labeled “DATA”.

b. Admin Network VOIP jacks to be white, labeled “VOICE”

c. Control Network SCADA jacks to be orange, labeled “SCADA”.

2. Process network jacks - panel/enclosure mounted:

a. Network jacks located in process areas shall have a NEMA Type 4 rating (with closure cap).

b. Mounting of network jacks in control panels shall be accomplished using bulkhead connectors and environmental enclosure caps, which are permanently attached to the bulkhead fitting.

c. Network jacks shall have RJ-45 connections on both sides of connector (bulkhead pass through) allowing for direct connection to the network switch and computer with standard patch cords. No punch down PC board connections shall be allowed.

d. Manufactured by Woodhead Connectivity RJLNXX.

3. Process network jacks - conduit body mounted:

a. Network jacks located in process areas shall have a NEMA Type 4 rating (with closure cap).

b. Mounting of network jacks in conduit bodies adapter (with minifast connector) shall be accomplished using conduit body insert and environmental enclosure caps.

c. PC board connections are not to be allowed.

d. Furnish 10 RJ-45 to minifast connector patch cable 3 feet in length, 600V rated.

e. Manufactured by InterlinkBT RSS series.

4. Network/phone jacks:

a. Network jacks located in computer rooms shall be installed per the installation details indicated on the Drawings.

b. Standard Decora wall plates shall be used with QuickPort modules and inserts.

c. Manufactured by Leviton Quickport series.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Mounting heights and requirements:

1. Process and production areas:

a. Switches and receptacles 48 inches from finished floor to top of plate.

2. Offices and finished areas:

a. Switches: 48 inches from finished floor to top of plate.

b. Receptacles: 24 inches from finished floor to center of plate.

c. Coordinate locations where counter tops and cabinets.

3. All locations shall have wiring devices installed within exposed surface mounted cast boxes with threaded fittings. Refer to Drawings if wiring device cast box is to be polyvinyl chloride coated.

C. Switches:

1. Over 300 Volts:

a. Where switches used in systems of more than 300 volts between conductors, are to be ganged in outlet boxes, provide switches having no exposed live parts or use barriers between the individual switches.

D. Receptacles:

1. Provide weather resistant receptacles in all exterior areas and protect with GFCI breakers. Provide exterior receptacles with “while in use” covers.

2. Provide GFCI receptacles where indicated on the Drawings.

3. Mount non-weatherproof receptacles vertically:

a. Ground slot down.

4. Mount weatherproof receptacles horizontally:

a. Neutral slot up.

5. 3-phase receptacles shall be consistent with respect to phase connection at the receptacle terminals. Correct errors in phasing at the source and not the receptacle.

E. Ensure all plates make a firm seal with wall for recessed mounted devices:

1. Outside edges of plates parallel with building lines.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 16050.

3.03 PROTECTION

A. Refer to Section 16050.

3.04 DEMONSTRATION AND TRAINING

A. As specified in Section 16050 and Section 01756.

B. Demonstrate the following to the ENGINEER and OWNER:

1. Switching is as indicated on the Drawings.
2. All circuits conform to the panel schedules.
3. All ground fault receptacles operate at levels below or equal to OSHA maximum allowable fault levels.
4. All Ethernet jacks are communicating to connected Ethernet switches.
5. Testing shall be part of General Start-Up and Testing Procedures. Refer to Section 01750.

END OF SECTION

SECTION 16150

LOW VOLTAGE WIRE CONNECTIONS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Wire connecting devices.
2. Terminations.
3. Splices.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 16050 - Common Work Results for Electrical.
   c. Section 16123 - 600 Volt or Less Wires and Cables.

1.02 REFERENCES

A. Refer to Section 16050.

1.03 DEFINITIONS

A. Refer to Section 16050.

1.04 SYSTEM DESCRIPTION

A. Provide a complete system of wiring connectors, terminators, fittings, etc. for a complete wiring system suitable for the cables and conductors used.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Catalog cut sheets.
2. Installation instructions.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. All materials shall be UL listed.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. Refer to Section 16050.

1.09 WARRANTY

A. Refer to Section 16050.

1.10 SYSTEM STARTUP

A. Refer to Section 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers for each type of technology are specified with the equipment herein.

2.02 EQUIPMENT

A. Control connections:

1. For PLC Panels, MCCs, and LCPs provide control wiring connections as required based on terminal type from approved shop drawings :

2. For vendor supplied process equipment provide control wiring connections as required based on terminal type from approved shop drawings.

3. Medium voltage protective relay current transformers and potential transformer wiring: use insulated ring type wire terminators for connections to all screw terminals:

a. With chamfered/funneled terminal barrel entry.

b. Deep internal serrations.

c. Long barrel design.

d. Electroplated-tin copper material.

e. Manufacturer: the following, no equal:

1) Thomas and Betts Sta-Kon.

4. Medium voltage protective relay control circuits wiring: use insulated spade type wire terminators for connections to all screw terminals:

a. With chamfered/funneled terminal barrel entry.

b. Deep internal serrations.

c. Long barrel design.

d. Electroplated-tin copper material.

e. Manufacturer: the following, no equal:

1) Thomas and Betts Sta-Kon.

B. Joints, splices, taps, and connections:

1. 600-volt conductors:

a. Use solderless connectors.

b. Use only plated copper alloy connectors or lugs:

1) Aluminum connectors or lugs are not acceptable for copper conductors.

c. Under those specific conditions where aluminum conductors have been allowed or are specified then the connectors for aluminum conductors shall be specifically designed for that purpose.

d. For wire No. 10 AWG and smaller use twist on connectors:

1) Shell rated for 105 degree Celsius. Reusable.

2) UL listed, 600 Volt rated.

3) Manufacturer: One of the following or equal:

a) 3M 312, 412 or 512 Spring Connector

b) Ideal Wing-Nut

e. For wire No. 8 AWG and larger, use heavy duty copper compression connectors:

1) Manufacturer: One of the following or equal:

a) Burndy.

b) Thomas and Betts.

f. Heat shrink tubing:

1) Suitable for indoors, outdoors, overhead, direct burial or submerged applications.

2) Minimum shrink ratio: 4 to 1.

3) Continuous operating temperature: -55 degrees Celsius to 110 degrees Celsius.

4) Internally applied adhesive sealant.

5) Cross-linked polyolefin:

a) Manufacturers, one of the following or equal:

(1) 3M ITCSN.

(2) Thomas & Betts Shrink-Kon.

2. Instrumentation class cable splices:

a. Suitable for indoor, outdoors, weather exposed, direct buried, or submersed applications.

b. Utilizing an epoxy, polyurethane, and re-enterable compounds.

c. For use with shielded or unshielded plastic- and rubber-jacketed, signal, control, and power cables rated up to 1 kV.

d. Two-part mold body with tongue and groove seams and built in spacer webbing.

e. Manufacturer: One of the following or equal:

1) 3M Scotchcast 72-N.

C. Motor connections (600 volts and below):

1. Manufacturer: One of the following or equal:

a. T&B Shrink-Kon MSC Series

D. Insulating tape:

1. General purpose insulating tape:

a. Minimum 7 mil vinyl tape.

b. Suitable for application in an ambient of -18 degrees Celsius (0 degrees Fahrenheit).

c. Operating range up to 105 degrees Celsius (220 degrees Fahrenheit).

d. Flame retardant, hot- and cold- weather resistant, UV resistant.

e. For use as a primary insulation for wire cable splices up to 600 VAC.

f. Meeting and complying with:

1) ASTM D-3005 Type I.

2) UL 510.

3) CSA C22.2.

g. Manufacturer: the following, no equal:

1) 3M Super 33+.

2. General-purpose color-coding tape:

a. Minimum 7 mil vinyl tape.

b. Suitable for application on PVC and polyethylene jacketed cables.

c. For use indoors and outdoors in weather protected enclosures.

d. Available with the following colors:

1) Red.

2) Yellow.

3) Blue.

4) Brown.

5) Gray.

6) White.

7) Green.

8) Orange.

9) Violet.

e. For use as phase identification, marking, insulating, and harnessing.

f. Meeting and complying with:

1) UL 510.

2) CSA C22.2.

g. Manufacturer: the following, no equal:

1) 3M 35.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Load connections:

1. Connect loads to the circuits as indicated. Color-code all branch circuits as specified in Section 16123.

C. Zero to 600-volt systems:

1. Make all connections with the proper tool and die as specified by the device manufacturer.

2. Use only tooling and dies manufactured by the device manufacturer.

3. Insulate all connections and splices with Scotch 33+ tape and Scotchfill, or pre-molded plastic covers, or heat shrink tubing and caps.

4. Number all power and control wires before termination.

D. Motor connections (600 volts and below):

1. Terminate wires with re-enterable motor stub insulator.

2. Wire markers shall be readable after boot installation.

3. In damp and wet locations or where subject to submergence, use a complete kit containing mastic that shall seal out moisture and contamination.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 16050.

3.03 PROTECTION

A. Refer to Section 16050.

END OF SECTION

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SECTION 16210

UTILITY COORDINATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Coordination with the utility companies to provide service.
2. CONTRACTOR's responsibilities for connecting to utilities and providing utility service to the facilities.
3. Provide the following work per SMUD requirements:
   a. Provide underground conduits, pull boxes, pole mounted riser, etc per SMUD engineered drawings.
   b. SMUD will provide 21kV service conductors to new metering switchgears. CONTRACTOR shall make terminations at new metering switchgears.
4. Contact SMUD's Meter Shop for mandatory panel/switchgear pre-inspection, 916-732-5390.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. Refer to Section 16050.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Electrical service:

1. Provide all Work and materials and bear all costs for providing temporary construction power and the permanent electrical service, including but not limited to:

    a. All Work and materials not provided by the electric utility.

    b. OWNER shall pay all permits and fees required by the electric utility, except those caused by CONTRACTOR work and or scheduling requiring extra work from SMUD.

2. Provide electrical ducts, raceways, pull boxes, pull tape and 21 kV/480V cable connections as indicated on the Drawings, and all other Work and materials required for a complete electrical service, including but not limited to the following:

    a. Electrical service conduits from the points of electric utility connection to the service entrance equipments. Provide for all SMUD inspections.

    b. Provide metering equipment with main circuit breakers. Same shall be approved by SMUD.

    c. Provide all testing as required.

B. General:

1. Coordinate and obtain inspections and final installation approval from the serving utilities and other authorities having jurisdiction.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Certification:

1. Submit certification that the intended installation has been coordinated with the utility companies.

2. Include a narrative description of the utility's requirements and points of connection, names and telephone numbers for contacts at the utilities.

3. Submit proof of SMUD approval of 21 kV metering cubicles complete with main circuit breakers and protective relays.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Materials and equipment used in performance of Electrical Work shall be listed or labeled by Underwriter's Laboratories, or other equivalent recognized independent testing laboratory, for the class of service intended.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 SCHEDULING

A. General:

1. Before start of Site Work, make arrangements for temporary electrical service as required.

B. Electrical systems:

1. Before bidding, the electrical contractor shall contact SMUD to determine the Work and materials that will be required from the CONTRACTOR, so that all utility systems furnished by the CONTRACTOR will be included in the bid.

2. Coordinate Work with ENGINEER to minimize downtime of existing operating equipment and electrical distribution systems and to preclude unsafe operation:

a. Notify 10 days before power interruptions.

b. Coordinate downtime of any existing facility with OWNER and SMUD.

3. Before commencing Work, coordinate electric service entrance requirements with SMUD to assure that the installation will be complete as specified in these Contract Documents:

a. Ensure power transformers size, electrical characteristics, and locations are consistent with the design and service voltage provided by the electric utility coordinated with other trades.

b. Arrange for utility revenue meters.

c. Coordinate installation of metering CTs and PTs furnished by SMUD.

C. Before commencing Site Work, coordinate underground conduit installations with other Work to eliminate conflicts and avoid interferences with other underground systems.

1.09 WARRANTY

A. As specified in Section 16050.

1.10 SYSTEM START-UP

A. As specified in Section 16050.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Furnish materials in accordance with the applicable requirements of SMUD and as specified in these Specifications.

2.02 EQUIPMENT

A. Furnish equipment in accordance with the applicable requirements of SMUD and as specified in these Specifications.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050 and as required by SMUD.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050 and as required by SMUD.

3.03 CLEANING

A. As specified in Section 16050.

3.04 DEMONSTRATION AND TRAINING

A. As specified in Section 16050.

END OF SECTION

SECTION 16222

LOW VOLTAGE MOTORS UP TO 500 HORSEPOWER

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Low voltage motors up to 500 horsepower:

a. Furnished separately.

b. Part of driven equipment specified in other sections.

c. Other electric motors required for a complete installation.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

c. Section 16950 - Field Electrical Acceptance Tests.

1.02 REFERENCES

A. As specified in Section 16050.

B. American Bearing Manufacturers Association (ABMA):

1. 9 - Load Ratings and Fatigue Life for Ball Bearings.

2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. American Petroleum Institute (API):

1. 670 - Vibration, Axial Position, and Bearing Temperature Monitoring Systems.

D. ASTM International (ASTM).

1. B-117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

E. Institute of Electrical and Electronic Engineers (IEEE):

1. 43 - IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.
2. 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators.
3. 114 - Standard Test Procedure for Single-Phase Induction Motors.
4. 303 - Recommended Practice for Auxiliary Devices for Rotating Electrical Machines in Class 1, Division 2 and Zone 2 Locations.
5. 841 - Standard for Petroleum and Chemical Industry-Premium-Efficiency, Severe Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 370 kW (500 hp).
6. 1349 - Guide for Application of Electric Motors in Class I, Division 2 Hazardous (Classified) Locations.

F. National Electrical Manufacturers' Association (NEMA):

1. MG-1 - Motors and Generators.
2. MG-2 - Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators.

G. Underwriters Laboratories Inc. (UL):

1. 674 - Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

1.03 DEFINITIONS

A. As specified in Sections 16050.

1.04 SYSTEM DESCRIPTION

A. Furnish and install electric motors and accessories as specified in this Section and the Sections specifying driven equipment to provide a complete and operable installation.

B. All motors larger than 5 horsepower and installed outdoors shall include motor winding heaters.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Submit completed motor data sheets for each motor supplied:

1. Conform to data sheet in the appendix of this Section.
2. Manufacturer’s or other data sheets are not acceptable.

C. Product data:

1. Descriptive bulletins.
2. Machine tag and loop number as indicated on the Drawings, and in the specification section number of the driven machine.

3. Complete electrical data.

4. Torque, current, and power factor vs. speed curves:

   a. At 100 percent rated voltage for all full voltage started and VFD driven motors.

   b. For motors on reduced voltage start at 70, 80, 90, and 100 percent rated voltage

5. Accessories data:

   a. Power factor correction capacitors:

      1) Size in KVAR, for all motors not connected to variable frequency drives where shown on Contract Drawings. Include capacitors for RVSS type starters where applicable.

   b. Motor winding heaters:

      1) Voltage.

      2) Watts.

   c. Winding temperature detectors:

      1) Type.

      2) Rating.

   d. Moisture detectors.

6. Mechanical data:

   a. Bearing design and bearing life calculations.

   b. Resonant frequencies for all VFD-driven motors 50 horsepower or greater.

D. Shop drawings:

1. Motor weight.

2. Frame size.

3. Conduit boxes, dimensions, and locations.

4. Outline drawings with dimensions.

5. Installation details for the project seismic criteria.

E. Test reports:

1. Factory test reports with test reference standard identified.

F. Certification:

1. When motors are driven by variable speed drive systems, submit certification that selected motor:

   a. Is capable of satisfactory performance under the intended load.

   b. Meets the requirements of the latest edition of NEMA MG-1 Part 31.

   c. Is matched to the type of variable frequency drive specified.

G. Calculations:

1. Where site conditions specified in Section 16050 exceed manufacturer's ratings, provide derating calculations for each motor.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

B. Motors 200 hp and larger:

1. Rotate shaft 90 degrees once per month while in storage and prior to be in service.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 WARRANTY

A. As specified in Section 16050.

1.10 SYSTEM STARTUP

A. As specified in Section 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. US Motors.
2. General Electric.
3. Reliance.
4. Toshiba.
5. Baldor.

2.02 EQUIPMENT

A. 3-phase induction motors - general:

1. Voltage:

a. All motors 1/2 hp and larger shall be rated 460 V, 3 phase unless otherwise indicated on the Drawings.

b. Dual voltage motors rated 230/460 V, 3 phase are acceptable provided all leads are brought to the conduit box.

2. Motors driving identical machines shall be identical.

3. All motors greater than 1 hp and up to 500 hp shall meet the "NEMA Premium Efficiency" percent listed in NEMA MG-1.

4. Horsepower as indicated on the Drawings:

    a. Horsepower ratings indicated on the Drawings are based on vendor's estimates. Provide motors sized for the load of the actual equipment furnished without operating in the service factor.

5. Service factor:

    a. 1.15 service factor.

    b. 1.0 when driven by VFD.

6. Torque:

    a. Provide motors that develop sufficient torque for acceleration to full speed at voltage 10 percent less than motor nameplate rating.

    b. When started using reduced voltage starters:

        1) Provide motors that develop sufficient torque for acceleration to full speed.

    c. NEMA Design B except where driven load characteristics require other than normal starting torque:

        1) In no case shall starting torque or breakdown torque be less than the values specified in NEMA MG-1.

7. Enclosures:

    a. As specified in the individual equipment Specifications or in this Section.

    b. Totally enclosed fan cooled:

        1) Cast iron conduit box.

        2) Tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller, and automatic breather and drain devices for frames 324T and larger.

    c. Explosion-proof:

        1) Tapped drain holes with corrosion resistant plugs for frames 286T and smaller and automatic breather and drain devices for frames 324T and larger.

    d. Lifting devices: All motors weighing 265 pounds (120 kilograms) or more shall have suitable lifting devices for installation and removal.

8. Manufactured with cast iron frames in accordance with NEMA MG-1 or manufacturer's standard material for the specified rating.

9. Nameplates:

    a. Provide all motors with a permanent, stainless steel nameplate indelibly stamped or engraved with:

        1) NEMA standard motor data.

            a) Indicate compliance with NEMA MG-1 Part 31 for inverter duty motors.

2) AFBMA bearing numbers and lubrication instructions.

10. Hardware:

a. Type 316 stainless steel.

11. Conduit boxes:

a. Cast iron or stamped steel.

b. Split from top to bottom.

c. Provide gaskets at the following interfaces:

1) Frames and conduit boxes.

2) Conduit boxes and box covers.

d. Rotatable through 360 degrees in 90-degree increments.

1) Where available based on the size of the conduit box.

e. Exceeding the dimensions defined in NEMA MG-1.

f. Provide grounding lugs inside conduit boxes for motor frame grounding.

12. Motor bearings:

a. Antifriction.

b. Regrease-able and initially filled with grease for horizontal motors, vertical motors per manufacturer's standard design.

c. Bearings and lubrication suitable for ambient temperature and temperature rise.

d. Suitable for intended application and have ABMA L-10 rating life of 60,000 hours or more.

e. Fit bearings with easily accessible grease supply, flush, drain, and relief fittings using extension tubes where necessary.

f. Where specified in the equipment Specifications, provide split-sleeve type hydrodynamic radial bearings. Provide a bearing isolator to protect bearings from contaminants.

13. Insulation systems:

a. Motors installed in ambient temperatures 40 degrees Celsius or less:

1) Provide Class F insulation.

2) Design temperature rise consistent with Class B insulation.

3) Rated to operate at an ambient temperature of 40 degrees Celsius at the altitude where the motor will be installed.

b. Motors installed in ambient temperatures between 40 degrees Celsius and 50 degrees Celsius:

1) Provide Class F insulation.

2) Design temperature rise consistent with Class B insulation.

3) Rated to operate at an ambient temperature of 50 degrees Celsius at the altitude where the motor will be installed.

c. Motors installed in ambient temperatures between 50 degrees Celsius and 65 degrees Celsius:

1) Provide Class H insulation.

2) Design temperature rise consistent with Class F insulation.

3) Rated to operate at an ambient temperature of 65 degrees Celsius at the altitude where the motors will be installed.

14. Motor leads:

a. Insulated leads with non-wicking, non-hydroscopic material. Class F insulation.

15. Noise:

a. Maximum operating noise level in accordance with NEMA MG-1.

B. Submersible motors:

1. Enclosures:

a. Totally enclosed non-ventilated (TENV) watertight casing.

b. Inner and outer shaft seals separated by an oil chamber.

2. Cooling:

a. Suitable for continuous operation in totally, partially or non-submerged condition without overheating.

b. Convection cooling by the surrounding environment or pump cooling by circulating a portion of the pumped media through a cooling water jacket as recommended by the manufacturer based on horsepower and application.

3. Electrical cables:

a. Wire unit without splices. Coordinate with CONTRACTOR to ensure cables of adequate length.

b. Epoxy encapsulated cable entry into terminal box.

4. Insulation:

a. Sealed moisture resistant windings.

b. Class H.

5. Motor protection:

a. Provide temperature detection in motor windings.

b. Provide moisture detection in motor housing.

c. Other detection and protection functions specified in the in the driven equipment Section.

C. Vertical motors:

1. Enclosures:

   a. Totally enclosed fan cooled (TEFC) for motors 200 horsepower and less installed outdoors.

   b. Weather protected Type II (WPII) for motors greater than 200 horsepower installed outdoors.

   c. Weather protected Type I (WPI) where installed indoors.

2. Thrust bearings:

   a. Selected for combined rotor and driven equipment loads.

   b. Coordinate with driven equipment supplier for maximum vertical thrust of driven equipment.

3. Anti-reverse ratchet.

D. Motors driven by variable frequency drives:

1. Compatible with the variable frequency drives specified.

2. Inverter duty rated and labeled.

3. Meet the requirements of NEMA MG-1 Part 31.

4. Winding insulation meets the requirements of NEMA MG-1 Part 31.4.4.2.

5. Capable of running continuously at 1/10th of full speed, with no harmful effects or overheating.

6. Shaft grounding ring:

   a. Provide a shaft grounding ring for each VFD driven motor.

   b. Aluminum frame and internal components.

   c. Conductive microfiber brushes.

   d. Maintenance free design.

   e. Aegis Bearing Protection ring as manufactured by Electro Static Technology or equal.

E. Motors installed in hazardous locations:

1. Class I, Division 1 or Class II, Division 1 areas:

   a. Enclosures:

      1) Explosion proof for 3-phase motors.

      2) UL listed in conformance with UL-674.

      3) UL approval with nameplate and serial number.

2. Other hazardous areas:

   a. Enclosures:

      1) TEFC for motors in Class I, Division 2 areas.

      2) Vertical motors as specified herein.

3) Hazardous area and temperature code approval stamped on nameplate.

3. Single phase motors: Explosion proof motor enclosure.

F. Motors installed in corrosive environments:

1. Nameplate indicating conformance to Corrosive Duty.
2. Stator double dipped in varnish and baked.
3. Stator and rotor coated with corrosion resistant epoxy.
4. Frame, brackets, fan guard and conduit box coated with minimum of 2 coats of epoxy paint.
5. Withstand salt spray tests in accordance with ASTM B-117.
6. Suitable for hose down areas.

G. Single phase motors:

1. Capacitor start type rated for operation at 115 volts, 60 hertz, unless otherwise specified or as indicated on the Drawings.
2. Totally enclosed fan cooled (TEFC) motors manufactured in accordance with NEMA MG 1.
3. Ball bearings: Sealed.
4. 1/2 horsepower or less fan motors:
   a. Split-phase or shaded pole type when standard for the equipment.
   b. Open type when suitably protected from moisture, dripping water, and lint accumulation.
5. Wound rotor or commutator type single-phase motors only when their specific characteristics are necessary for application and their use is acceptable to the ENGINEER.
6. Integral overload protection.

2.03 ACCESSORIES

A. Motor winding heaters:

1. Provide all 3 phase motors with belted or cartridge space heaters mounted within the motor enclosure.
2. Space heater rating shall be 120 volts, single-phase, unless otherwise indicated on the Drawings.
3. Power leads for heaters wired into conduit box.
4. Installed within motor enclosure adjacent to core iron.

B. Winding temperature detectors:

1. Provide factory installed winding temperature detector with leads terminating in the conduit box:
   a. Where required by the driven equipment Specification or as indicated on the Drawings.

b. RTD type, 2 per phase, 100 ohm platinum.

2. Temperature switches with normally closed contacts as indicated on the Drawings.

C. Bearing temperature detectors:

1. Where required by the driven equipment Specification or as indicated on the Drawings.

2. RTD type and wiring matches the winding RTDs.

D. Vibration detectors:

1. Where required by the driven equipment Specification.

2. As specified in the driven equipment Specification.

2.04 SOURCE QUALITY CONTROL

A. Factory Testing (Performance Testing):

1. Motors less than 250 horsepower:

a. Perform manufacturer's standard production tests including but not limited to:

1) No load current.

2) High potential test.

3) Winding resistance.

b. Furnish copies of standard test reports on prototype or identical units.

2. Motors 250 horsepower and larger:

a. Perform tests in accordance with IEEE 112 or IEEE 43.

b. Tests shall include the following:

1) Winding resistance (cold).

2) Locked rotor test.

3) Temperature rise test.

4) Load test.

5) Breakdown torque test.

6) No-load test.

7) High-potential test.

8) Insulation resistance test.

9) Vibration test per NEMA MG-1.

10) Polarization index.

11) Speed-torque curve.

12) Shaft voltage.

13) Bearing insulation resistance.

14) Efficiency and power factor versus load test performed at rated speed and 50 percent, 75 percent, 90 percent, and 100 percent of rated load. The curves from the motor tests shall be submitted for information.

15) The maximum allowable residual unbalance in each correction plane (journal) shall be calculated using the following equation:

$$U = 4\ W/N$$

where:

U = residual correction plane unbalance, in ounces-inches

W = static correction plane journal loading, in pounds

N = maximum specified operating speed, in revolutions per minute.

c. Furnish copies of test reports.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Install motors in accordance with manufacturer's instructions.

C. Install shaft grounding ring on VFD driven motors in accordance with the manufacturer’s instructions.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Before start-up, perform insulation resistance test on each motor furnished or installed on this project:

1. Windings energized to 1,000 volts DC for 1 minute.
2. Resistance measured at the end of the test, recorded, and submitted to the ENGINEER for review.
3. Inform the ENGINEER of any unusual or unacceptable test results.
4. This test is in addition to the acceptance tests in Section 16950 as part of the General Start-Up and Testing Procedures.

3.03 PROTECTION

A. As specified in Section 16050.

MOTOR DATA SHEET

EQUIPMENT
NUMBER : _____ NAME : _____

SPECIFICATION SECTION NUMBER OF MOTOR: _____

NAMEPLATE DATA - FIELD RECORDED

MANUFACTURER	MODEL #	SERIAL #	FRAME #

H.P.	R.P.M	F.L.A	NO LA	LRA	VOLTS	PHASE	FREQ.

CODE	N.E.M.A.	INSUL.	ENCLOSR.	DUTY	DESIGN	P.F.	S.F.

ACCESSORIES

WINDING HEATER		WINDING	RTD				
VOLTS	WATTS	TEMP SW (Y/N)	TYPE	QTY/PH	# WIRES	OHM	TEMP

SPECIAL APPLICATIONS

INVERTER DUTY (Y/N) ____ PART WINDING (Y/N) _____ Y-DELTA (Y/N) _____

2 SPEED, 1 WINDING (Y/N) _____ 2 SPEED, 2 WINDING (Y/N) _____

AREA CLASSIFICATION:

CLASS _____ DIVISION _____ GROUP: _____ TEMP CODE: _____

END OF SECTION

SECTION 16262

VARIABLE FREQUENCY DRIVES 0.50 – 50 HORSEPOWER

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Variable frequency drives (VFD) 0.5 to 50 horsepower for control of NEMA Design B squirrel cage induction motors

a. Vendor furnished panels and equipment.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 01750 – Testing, Training and Facility Startup.

c. Section 16050 - Common Work Results for Electrical.

d. Section 17710 - Control Systems - Panels, Enclosures and Panel Components.

1.02 REFERENCES

A. As specified in Section 16050.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts maximum).

2. MG 1, Part 31 - Definite-Purpose Inverter-Fed Polyphase Motors.

C. Institute of Electrical and Electronics Engineers (IEEE):

1. 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

D. Underwriters' Laboratories (UL):

1. 50 - Standard for Enclosures for Electrical Equipment.

2. 508A - Standard for Industrial Control Panels.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions:

1. Point of common coupling: the point of common coupling for all harmonic calculation and field measurements for both voltage and current distortions is defined as the closest directly connected panelboard or motor control center bus supplying power to the VFD.

1.04 SYSTEM DESCRIPTION

A. Design requirements:

1. Each VFD system consists of all components required to meet the performance, protection, safety, testing, and certification criteria of this Section.

2. The VFD system:

a. Is a fully integrated package.

b. Includes all material necessary to interconnect all VFD system elements, even if shipped separately.

3. VFD Panels shall accept single source of electrical supply and distribute and transform power as required to meet the requirements of the Contract Drawings, Specifications and Control Strategies.

4. Each VFD shall be completely factory pre-wired, assembled, and then tested as a complete system by the VFD panel supplier to ensure a properly coordinated, fully integrated drive system.

5. Each VFD shall be provided and configured for communication over Modbus TCP. Each VFD shall provide for control and monitoring and hardwired input alarms over Modbus TCP network. CONTRACTOR shall coordinate IP address with OWNER. Refer to Instrumentation Drawings, Electrical Drawings and Control Strategies.

6. The VFD shall be capable of operating standard NEMA Design B motors. It is the responsibility of the VFD panel supplier to ensure that the drive will not damage motor insulation due to high carrier frequency, reflected wave, dv/dt or other drive electrical characteristics based upon the installed conditions:

a. Provide equipment necessary to mitigate potential damage to motor insulation.

7. VFD shall limit the current harmonic distortion to less than 10%.

B. Any modifications to a standard product necessary to meet this Section shall be made only by the VFD manufacturer.

C. Performance:

1. Operating envelope:

a. Speed and torque requirements:

1) Provide a variable torque or constant torque VFD as required by the driven load.

b. Current requirements:

1) 100 percent of rated current output on a continuous basis.

2) Variable torque VFD:

a) Minimum 110 percent current overload for 1 minute.

3) Constant torque VFD:

a) Minimum 150 percent current overload for 1 minute.

2. Minimum VFD system efficiency:

a. 96 percent.

b. VFD system efficiency shall be calculated as follows:

$$\text{Efficiency } (\%) = \frac{\text{Power (Load)}}{\text{Power (Supply)}} \times 100$$

D. Power (Load) is the total power measured at the output terminals of the drive system, including VFD, output filters, or transformers. Power (Supply) is the total power measured at the input terminals of the VFD including input filters, line reactors, isolation transformers, harmonic distortion attenuation equipment and auxiliary equipment (e.g., controls, fans) for complete system operation.

1. Total power factor:

a. Minimum of 0.96 lagging across the entire speed range.

b. At no speed shall the VFD have a leading power factor.

2. Frequency accuracy:

a. Minimum of within 0.1 percent.

3. Speed regulation:

a. Minimum of within 0.5 percent across the entire speed range.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050:

1. Custom prepared by the VFD panel supplier and specific for the equipment furnished.

B. Product data:

1. Manufacturer of the VFD.

2. Manufacturer of all components of the VFD.

3. Dimensions:

a. Height.

b. Width.

c. Depth.

d. Weight.

4. Nameplate schedule.

5. Bill of material.

6. Ratings:

a. Voltage.

b. Phase.

c. Input current.

d. Output current.

e. Interrupting rating.

f. Momentary current rating.

7. List of recommended spare parts.

8. Catalog cut sheets for major components.

9. Design data:

a. Efficiency and power factor values.

b. Certification that the drive is sized for the full nameplate motor horsepower and current of the driven load at the installed altitude and ambient temperature.

c. Certification that based upon VFD design, cable length to motor, and motor dielectric insulation level that the VFD will not damage motor insulation due to carrier frequency, reflected wave, dv/dt, or other VFD produced characteristics.

d. Certification that all electronic circuits and printed circuit boards are conformally coated.

10. List of recommended spare parts per panel.

C. Shop drawings shall be provided in AutoCAD and PDF formats including:

1. Complete plan and elevation drawings showing:

a. All dimensions.

b. Panel, sub-panel and component layout indexed to the bill of material.

c. Conduit connections.

d. Required clearance around panels.

e. Proof that panel is built by UL 508 listed shop.

2. Block diagram showing the basic control and protection systems specifying the protection, control, trip and alarm functions, the reference signals and commands and the auxiliary devices.

3. Complete schematic, wiring and interconnection diagrams showing connections to both internal and external devices:

   a. Wiring diagrams shall include terminal number and wire numbers.

4. Complete single-line and 3-line diagrams including, but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system:

   a. Clearly indicate device electrical ratings on the submittal drawings.

D. Installation instructions:

1. The written instructions must detail the complete installation of the VFD including moving, and setting into place.

2. Provide anchorage instructions and requirements for the VFD based on the seismic requirements at the project site as indicated in Section 16050:

   a. Stamped by a professional engineer registered in the state where the Project is being constructed.

E. Operation and maintenance manuals:

1. Spare parts list with supplier names and part numbers.

2. Startup and commissioning instructions and data.

3. Complete bill of material indexed to the drawings, identifying the catalog or part numbers, manufacturer, and quantities of components of the VFD system.

4. Operating manuals:

   a. Submit operating instructions and a maintenance manual presenting full details for care and maintenance of each model of VFD provided under this Contract.

5. Operating instructions:

   a. Written descriptions detailing the operational functions of all controls on the front panel.

6. Maintenance manual:

   a. Furnish maintenance manuals with instructions covering all details pertaining to care and maintenance of all equipment as well as identifying all parts.

   b. Manuals shall include, but are not limited to the following:

      1) Adjustment and test instructions covering the steps involved in the initial test, adjustment and start-up procedures.

      2) Detailed control instructions which outline the purpose and operation of every control device used in normal operation.

      3) All schematic wiring and external diagrams:

         a) Furnish drawings in a reduced 11-inch by 17-inch format that are fully legible at that size.

F. Test reports.

G. Manufacturer's field reports:

1. Certification letter from the VFD manufacturer that the VFD(s) has been inspected and installed in accordance with the manufacturer's requirements.

2. Report listing the setting of all VFD adjustable parameters and their values after start-up.

H. Record Documents:

1. Certified Record Documents of equipment with information listed above.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Qualifications:

1. Any third-party certification, safety, or protection requirements shall be applied to the VFD control panel as a whole. Certification or protection of system elements or individual components by themselves is not acceptable.

2. VFD control panel shall be UL 508C listed and labeled.

1.07 DELIVERY, STORAGE AND HANDLING

A. As specified in Section 16050.

B. Ship the VFD panels to the job site on a dedicated air ride vehicle that will allow the CONTRACTOR to utilize on site off-loading equipment:

1. VFD panels shall be delivered to the site preassembled and wired.

2. Furnish temporary equipment heaters within the VFD panels to prevent condensation from forming.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SEQUENCING

A. Submit equipment for review.

B. Following approved submittal, conduct internal factory test to ensure that all systems and equipment are functional and submit certified test results for ENGINEER's review.

C. Conduct factory acceptance test.

D. Ship equipment to project site after successful completion of factory acceptance test and results have been submitted and approved.

E. Install equipment in the field.

F. Submit manufacturer's certification that all equipment has been properly installed and is fully functional for ENGINEER's review.

G. Conduct field acceptance test and submit results for ENGINEER's review.

H. Conduct OWNER's training sessions.

I. Formally energize, start-up and commission equipment.

1.10 SCHEDULING

A. As specified in Section 16050.

1.11 WARRANTY

A. As specified in Section 16050.

1.12 SYSTEM STARTUP

A. As specified in Section 16050 and 01750.

B. CONTRACTOR shall be responsible to configure VFDs with motor data information, networked communication settings, and process operational settings. All configuration data shall be submitted and approved prior to start up. Coordinate with the City to configure the VFD for restart on power fail.

C. The VFD manufacturer shall be responsible for start up of the VFDs in the presence of the equipment suppliers, CONTRACTOR, ENGINEER, and OWNER.

1.13 MAINTENANCE

A. Spare parts:

1. The following spare parts shall be furnished:

a. One set of all power and control fuses for each VFD panel.

b. One complete main control key pad for each type and rated size of VFD.

c. One spare fan for each VFD panel.

d. Two sets of ventilation filters for each VFD panel.

e. One communication module per type provided.

f. All hardware and software required for configuration, maintenance, troubleshooting and inquiry of all drive parameters.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Allen-Bradley PowerFlex 700.

2. Eaton CFX9000.

2.02 EQUIPMENT

A. General:

1. Integrated clean power drive.

a. Six-pulse insulated gate bipolar transistor (IGBT) power section.

b. Microprocessor based controls.

2. Provide latest version of VFD available and include latest firmware at time of startup.

B. Ratings:

1. Voltage:

a. Input voltage: 480 volts within 10 percent, 3-phase, 60 hertz.

2. VFD horsepower rating shall be 115% or greater than connected load horsepower.

3. Enclosures shall be NEMA rated based on environment installed. Refer to Section 16050 if not specified on Contract Drawings.

C. Operational features:

1. Protective features:

a. Provide the following minimum protective features:

1) Motor overload protection.

2) Instantaneous overcurrent.

3) Instantaneous overvoltage.

4) Undervoltage.

5) Power unit overtemperature.

6) Phase loss.

7) VFD output short circuit.

2. Control mode:

a. Operation in either a constant volts/hertz or sensor-less vector mode:

1) The control mode is selectable using the programming keypad.

3. Frequency control:

a. Minimum of 3 selectable skip frequencies with adjustable bandwidths.

b. Programmable minimum frequency.

c. Programmable maximum frequency.

4. Acceleration/deceleration:

a. Separately adjustable acceleration and deceleration rates:

1) Each rate adjustable up to 360 seconds.

5. Spinning load:

a. The VFD shall be capable of determining the speed and direction of a spinning load, “catch” the load and accelerate or decelerate it without damage to the load.

6. Programmable loss of signal:

   a. Upon loss of speed reference the VFD shall be programmable to either:

      1) Stop.

      2) Maintain current speed.

      3) Default to pre-selected speed.

7. Inputs/Outputs:

   a. Manufacturer’s standard number the following:

      1) Analog inputs:

         a) 4-20 mA.

      2) Analog outputs:

         a) Programmable 4-20 mA isolated.

      3) Discrete inputs:

         a) Four programmable inputs for status, alarms.

         b) More as required based on schematics and Control Strategies.

      4) Discrete outputs:

         a) Programmable.

         b) Form C relay contacts.

      5) Potentiometer 3-wire input

   b. Provide additional inputs/outputs as required to meet the control functions indicated on the Drawings.

8. Communications:

   a. Provide each VFD with Modbus TCP communications and Cat 6 cable interface.

9. Diagnostics:

   a. Store a minimum of 4 fault conditions in non-volatile memory on a first in-first out basis.

   b. Operational parameters stored at the time of a the fault:

      1) Operating frequency.

      2) Drive status.

      3) Power mode.

   c. Fault memory accessible via network connection.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Install the VFD Panel per the supplier's guidelines and submitted installation instruction to meet the seismic requirements at the Project Site.

C. General:

1. Furnish all cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories needed to complete the installation of the VFD Panel.

2. Install the VFD Panel in the location indicated on the Drawings.

3. Furnish components and equipment as required to complete the installation.

4. Replace any hardware lost or damaged during the installation or handling to provide a complete installation.

5. Install free-standing enclosures on 3-1/2 inch raised concrete housekeeping pad:

a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.

b. Weld and/or bolt the VFD frame to the leveling channels.

6. Provide openings in top or bottom of the VFD (free-standing or within motor control center) enclosure for conduit only, no additional openings will be allowed:

a. Improperly cut holes will require that the entire panel be replaced:

1) No hole closers or patches will be allowed.

7. Bundle circuits together and terminate in each unit:

a. Tie with nylon wire ties.

b. Label all wires at each end with wire numbers shown on the approved control drawings.

c. All connections to and from the VFD (free-standing or within motor control center) enclosure must be made via terminal blocks.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Provide the services of a VFD panel supplier representative for startup assistance and training:

1. Inspection and field adjustment:

a. Supervise the following and submit written certification that the equipment and controls have been properly installed, aligned, adjusted, and readied for operation.

2. Startup field testing:

a. Provide technical direction for testing, checkout, and startup of the VFD equipment in the field.

b. Under no circumstances are any portions of the drive system to be energized without authorization from the supplier's representative.

c. Provide complete communications test for failures on network to communication interface modules. These modules must use Modicon standards. Modules shall contain a web page that displays errors, transmit timeouts, missed packets and collision errors. Modules must be factory tested and reports submitted.

C. Provide field acceptance testing per Section 16950 and 01750 as part of General Start-Up and Testing Procedures.

3.03 ADJUSTING

A. Make all adjustments as necessary and recommended by the supplier, ENGINEER, or testing firm.

B. Provide the services of a VFD panel supplier representative to make all drive parameters and protective device settings:

1. Protective device settings provided by the VFD manufacturer in accordance with the manufacturer of the driven equipment requirements.

2. Provide documentation of VFD configuration settings included but not limited to:

a. Motor data.

b. Network communication settings.

c. Minimum speed.

d. Maximum speed.

e. Skip speeds.

f. Current limit.

g. Acceleration time.

h. Deceleration time.

3.04 CLEANING

A. As specified in Section 16050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 16050.

B. Demonstrate the operation of each VFD to the ENGINEER's and OWNER's satisfaction.

C. Training:

1. Provide instruction of the OWNER’s operation and maintenance staff on the operation and maintenance of the VFD.

2. Separate classes are required for the operations staff and maintenance staff:

   a. Operations staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Operations training time is 4 hours (2 classes of 2 hours each):

      1) The sessions shall be scheduled with the OWNER to ensure all operators have the opportunity to attend.

   b. Maintenance staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Maintenance training time is 4 hours (2 classes of 2 hours each):

      1) The sessions shall be scheduled with the OWNER to ensure all maintenance staff has the opportunity to attend.

   c. Instruction shall occur at the OWNER's facility and shall utilize the actual VFDs installed at the site.

   d. Refer to Section 01750 for further training requirements.

D. Preventive maintenance procedures shall also be demonstrated for Owner personnel during this training period.

3.06 PROTECTION

A. As specified in Section 16050.

END OF SECTION

SECTION 16264

VARIABLE FREQUENCY DRIVES 60-500 HORSEPOWER

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Clean power 18 pulse variable frequency drives (VFD), 60 to 500 horsepower for control of standard NEMA Design B squirrel cage induction motors.

a. Specification covers VFDs furnished as part of Vendor furnished panels and equipment.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 01750 – Testing, Training and Facility Startup.

c. Section 16050 - Common Work Results for Electrical.

d. Section 17710 - Control Systems – Panels, Enclosures and Panel Components.

1.02 REFERENCES

A. As specified in Section 16050.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts maximum).

2. MG 1, Part 31 - Definite-Purpose Inverter-Fed Polyphase Motors.

C. Institute of Electrical and Electronics Engineers (IEEE):

1. 519 - Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

D. Underwriters' Laboratories (UL):

1. 50 - Standard for Enclosures for Electrical Equipment.

2. 508A - Standard for Industrial Control Panels.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions:

1. Point of common coupling (PCC): the point of common coupling for all harmonic calculation and field measurements for both voltage and current distortions is defined as the closest directly connected panelboard or motor control center bus supplying power to the VFD.

1.04 SYSTEM DESCRIPTION

A. Design requirements:

1. Each VFD system shall consist of all components required to meet the performance, protection, safety, testing and certification criteria of this Section.

2. The VFD system:

a. Is a fully integrated package.

b. Includes all material necessary to interconnect VFD system elements, even if shipped separately.

3. Any modifications to a standard product necessary to meet this Section shall be made only by the VFD manufacturer.

4. Each VFD included as part of a panel, shall be completely factory pre-wired, assembled and then tested as a complete package by the panel supplier to ensure a properly coordinated, fully integrated drive system.

a. Each panel shall accept single source of electrical supply and distribute and transform power as required to meet the requirements of the Contract Drawings, Specifications and Control Strategies.

5. The VFD shall be capable of operating standard NEMA Design B motors. It is the responsibility of the VFD panel supplier to ensure that the drive will not damage motor insulation due to high carrier frequency, reflected wave, dv/dt or other drive electrical characteristics:

a. The VFD panel supplier shall furnish equipment necessary to mitigate potential damage to motor insulation.

6. VFD shall limit the current harmonic distortion to 3% or less.

B. Any modifications to a standard product necessary to meet this Section shall be made only by the VFD manufacturer.

C. Performance:

1. Operating envelope:

a. Speed and torque requirements:

1) Provide a variable torque or constant torque VFD as required by the driven load.

2) The VFD shall be capable of producing a variable alternating voltage/frequency output to provide continuous operation over the 40 to 110 percent (25 to 66 Hertz) speed range.

b. Current requirements:

1) 100 percent of rated output current on a continuous basis.

2) Variable torque VFD:

a) Minimum 110 percent current overload for 1 minute.

3) Constant torque VFD:

a) Minimum 150 percent current overload for 1 minute.

2. Harmonics:

a. The VFD shall comply with IEEE 519-1992 for total harmonic and current distortion calculations and measurements. The VFD shall meet the following distortion limits:

1) Voltage harmonics: Individual or simultaneous operation of the VFD(s) shall not add more than 3 percent total harmonic voltage distortion while operating from the utility source or more than 5 percent total harmonic voltage distortion while operating from standby generation at the point of common coupling.

2) Current harmonics: The maximum allowable total harmonic current distortion limit for each VFD shall not exceed 3 percent
as measured at the point of common coupling.

3. Efficiency:

a. VFD system minimum efficiency shall be 95 percent at rated output. VFD system efficiency shall be calculated as follows:

$$Efficiency\ (\%) = \frac{Power\ (Load)}{Power\ (Supply)}\ x\ 100$$

b. Power:

1) Load power is the total 3-phase power measured at the output terminals of the drive system, including VFD, output filters or transformers.

2) Supply power is the total power measured at the input terminals of the VFD including input filters, line reactors, phase shifting transformer, harmonic distortion attenuation equipment and auxiliary equipment (e.g., controls, fans) for complete system operation.

4. Total power factor:

a. Minimum of 0.96 lagging across the entire speed range.

b. Under no operating conditions shall the VFD have a leading power factor.

5. Frequency accuracy:
    a. Minimum of within 0.01 percent.
6. Speed regulation:
    a. Minimum of within 0.5 percent across the entire speed range.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050:
    1. Custom prepared by the VFD panel supplier and specific for the equipment furnished.

B. Product data:
    1. Manufacturer of the VFD.
    2. Manufacturer of all components of the VFD.
    3. Dimensions:
        a. Height.
        b. Width.
        c. Depth.
    4. Weight.
    5. Nameplate schedule.
    6. Bill of material.
    7. Ratings:
        a. Voltage.
        b. Phase.
        c. Input current.
        d. Output current.
        e. Interrupting rating.
        f. Momentary current rating.
    8. Catalog cut sheets for major components.
    9. Design data:
        a. Efficiency and power factor values.
        b. Certification that the drive is sized for the full nameplate motor horsepower and current of the driven load at the installed altitude.
        c. Certification that based upon VFD design, cable length to motor, and motor dielectric insulation level that the VFD will not damage motor insulation due to carrier frequency, reflected wave, dv/dt, or other VFD produced characteristics.
        d. Certification that all electronic circuits and printed circuit boards are conformally coated.

10. List of recommended spare parts.

C. Shop drawings shall be provided in AutoCAD and PDF formats including:

1. Complete plan and elevation drawings showing:

a. All dimensions.

b. Panel, sub-panel and component layout indexed to the bill of material.

c. Conduit connections.

d. Required clearance around panels.

2. Block diagram showing the basic control and protection systems specifying the protection, control, trip and alarm functions, the reference signals and commands and the auxiliary devices.

3. Complete schematic, wiring and interconnection diagrams showing connections to both internal and external devices:

a. Wiring diagrams shall include terminal number and wire numbers.

4. Complete 1-line and 3-line diagrams including, but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system:

a. Clearly indicate device electrical ratings on the submittal drawings.

D. Installation instructions:

1. The written instructions must detail the complete installation of the VFD including moving, and setting into place.

2. Provide anchorage instructions and requirements for the VFD based on the seismic requirements at the Project Site as specified in Section 16050:

a. Stamped by a Professional Engineer licensed in the state where the Project is being constructed.

E. Calculations:

1. Harmonic study:

a. A preliminary harmonic analysis shall be performed. A power system short circuit ratio of 20 shall be used. All VFDs shall be assumed to be operating at maximum speed and maximum load. The short circuit current (ISC) utilized for the harmonic analysis calculations is defined as:

1) ISC = 20 * (Sum Total Full Load Amps of all VFDs).

2. Detailed calculations or details of the actual physical testing performed on the VFD to prove the VFD as part of the control panel is suitable for the seismic conditions at the Project Site.

F. Test reports.

1. Provide the following certified test reports for the actual VFDs being furnished:

a. Efficiency at 25 percent, 50 percent, 75 percent, and 100 percent speed.

b. Power factor at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent speed.

c. Certification that the actual measured harmonic distortion for both voltage and current is within the specification limits at the installed site.

d. Certification that the actual measured voltage at the motor terminations is less than 90 percent of the motor insulation dielectric withstand level.

G. Record documents:

1. Certified record documents of all equipment with information listed above.

H. Supplier's field reports:

1. Report listing the setting of all VFD adjustable parameters and their values after start-up.

I. Operation and maintenance manuals:

1. Spare parts list with supplier names and part numbers.

2. Start-up and commissioning instructions and data.

3. Complete bill of material indexed to the drawings, identifying the catalog or part numbers, manufacturer, and quantities of components of the VFD system.

4. Operating manuals:

a. Submit operating instructions and a maintenance manual presenting full details for care and maintenance of each model of VFD provided under this Contract.

5. Operating instructions:

a. The written descriptions shall detail the operational functions of all controls on the front panel.

6. Maintenance manual:

a. Furnish maintenance manuals with instructions covering all details pertaining to care and maintenance of all equipment as well as identifying all parts.

b. Manuals shall include but are not limited to the following:

1) Adjustment and test instructions covering the steps involved in the initial test, adjustment and start-up procedures.

2) Detailed control instructions which outline the purpose and operation of every control device used in normal operation.

3) All schematic wiring and external diagrams:

a) Furnish drawings in a fully legible reduced 11-inch by 17-inch format.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Qualifications:

1. Any third party certification, safety or protection requirements shall be applied to the VFD control panel as a whole. Certification or protection of system elements or individual components by themselves is not acceptable.

2. VFD control panel shall be UL 508C listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

B. Ship VFD panels to the job site on a dedicated air ride vehicle that will allow the CONTRACTOR to utilize on site off-loading equipment:

1. VFD panels shall be delivered to the site pre-assembled and wired.

2. Furnish temporary equipment heaters within the VFD to prevent condensation from forming.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SEQUENCING

A. Furnish complete submittals for review.

B. Following approved submittal, conduct internal factory test to ensure that all systems and equipment are functional and submit certified test results for ENGINEER's review.

C. Conduct factory acceptance test. The factory acceptance test shall be witnessed by OWNER and/or OWNER's representative at the OWNER's discretion.

D. Ship equipment to Project Site after successful completion of factory acceptance test.

E. Install equipment in the field.

F. Conduct field acceptance tests including harmonic testing and submit results for ENGINEER's review.

G. Submit manufacturer's certification that all equipment has been properly installed and is fully functional for ENGINEER's review.

H. Conduct OWNER's training sessions.

I. Formally energize, start-up and commission equipment.

1.10 SCHEDULING

A. As specified in Section 16050.

1.11 WARRANTY

A. As specified in Section 16050.

B. Performance guaranty:

1. Guaranty that the harmonics at the point of common connection are at or below the levels specified.

2. Guaranty that the power factor at the input to the VFD meets the levels as specified herein.

3. Guaranty that the measured reflected voltage at the motor is below the motor insulation dielectric withstand level as specified herein.

4. VFDs that fail to meet the specified harmonics, power factor or reflected voltage criteria shall be repaired or replaced at the OWNER's discretion.

5. Guaranty that the efficiency of VFD is at or greater than the levels specified.

a. For each VFD that fails to meet the specified efficiency, the OWNER shall be reimbursed for the difference between the specified efficiency and measured efficiency at the rate of $0.05 per kilowatt hour, for operation at 24 hours per day, 365 days per year, for 10 years.

1.12 SYSTEM START UP

A. As specified in Section 16050 and 01750.

B. The VFD manufacturer shall be responsible for start up of the VFDs in the presence of the equipment suppliers, CONTRACTOR, ENGINEER, and OWNER. CONTRACTOR shall be responsible to configure VFDs with motor data information, networked communication settings, and process operational settings. All configuration data shall be submitted and approved prior to start up. Coordinate with the City to configure the VFD for restart on power fail.

1.13 MAINTENANCE

A. Maintenance service: Manufacturer shall describe the field service system available to support the proposed VFD system. As a minimum describe:

1. Type of technical support available (e.g., system engineering and technician).

2. Location of field service personnel.

3. Field service daily rates in dollars per hour and dollars per day.

4. Guaranteed response times to service requests.

B. Spare parts:

1. Furnish the following spare parts:

a. 1 set of all power and control fuses for each VFD panel.

b. 1 complete main control keypad for each type and rated size of VFD.

c. 1 spare fan for each VFD panel.

d. 2 sets of ventilation filters for each VFD panel.

e. One communication module per type provided.

f. All hardware and software required for configuration, maintenance, troubleshooting and inquiry of all drive parameters.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following, or equal:

1. Allen-Bradley 700.
2. Eaton CPX900.
3. Square D.

2.02 EQUIPMENT

A. General:

1. Sinusoidal pulse width modulated (PWM) type drive.
   a. Input line reactors if required based on harmonic study.
   b. Integral phase shifting auto-transformer.
   c. Direct current link with capacitors.
   d. Minimum 18-pulse diode rectifier section consisting of 3 three-phase bridge rectifiers.
      1) Specifically designed as a system to share currents between the bridges to within 1 percent.
      2) VFD designs utilizing the 6 diodes internal to the inverter and 12 diodes external to the inverter unit are not allowed.
   e. Insulated gate bipolar transistor (IGBT), inverter section.
   f. Microprocessor based controls.
2. VFDs that have an active input section for either harmonic or voltage control are not acceptable.

B. Ratings:

1. Voltage:
   a. Input voltage: 480 Volts plus or minus 10 percent, 3-phase 60 hertz.

C. Operational features:

1. Protective features:
   a. Include the following protective features:
      1) Motor overload protection.
      2) Instantaneous overcurrent.
      3) Instantaneous overvoltage.

4) Undervoltage.

5) Power unit overtemperature.

6) Phase loss.

7) VFD output short circuit.

8) VFD output ground fault.

9) Blown fuse.

2. Control mode:

a. The VFD shall operate in a either a constant volts/hertz or sensor-less vector mode. The control mode is selectable using the programming keypad.

3. Frequency control:

a. Minimum of 3 selectable skip frequencies with adjustable bandwidths for variable torque applications.

b. Programmable minimum frequency.

c. Programmable maximum frequency.

4. Acceleration/Deceleration:

a. Separately adjustable acceleration and deceleration rates.

b. Each rate shall be adjustable up to 3,600 seconds.

5. Spinning load:

a. Capable of determining the speed and direction of a spinning load, “catch” the load and accelerate or decelerate it without damage to the load.

6. Programmable loss of signal:

a. Upon loss of reference speed signal the VFD shall be programmable to either stop, maintain current speed, or default to preselected speed.

7. Input/Output:

a. Manufacturer’s standard number the following:

1) Analog inputs.

a) 4-20 milliamperes.

2) Analog outputs.

a) Programmable 4-20 milliamperes isolated.

3) Discrete inputs.

a) Programmable.

4) Discrete outputs.

a) Programmable.

b) Form C relay contacts.

5) Potentiometer 3-wire input.

b. Provide additional inputs/outputs as required to meet the control functions indicated on the Drawings and as required by Control Strategies.

8. Communications:

a. Provide each VFD with Modbus TCP communications and Cat 6 cable interface.

9. Diagnostics:

a. Store a minimum of 4 fault conditions in non-volatile memory on a first in-first out basis.

b. Operational parameters stored at the time of a the fault:

1) Operating frequency.

2) Drive status.

3) Power mode.

c. Fault memory accessible via network connection.

2.03 COMPONENTS

A. Enclosure:

1. Per Specification or as required by panel supplier.

2. Provide cooling devices required to maintain the VFD within the manufacturer's specified temperature limits for the Project conditions:

a. Provide cooling device alarm.

B. Power disconnect:

1. Flange mounted thermal magnetic circuit breaker:

a. Lockable in the OFF position.

C. Phase shifting transformer:

1. Auto-transformer.

2. Integral part of the VFD assembly and factory mounted and wired within the VFD enclosure.

3. Rated for rectifier duty.

4. Copper windings with 220-degree Celsius insulation.

D. Keypad:

1. Furnished with a keypad for programming and control.

2. Password security to protect drive parameters.

3. Mounted on the door of the enclosure.

4. Back-lit LCD with a minimum of 2 lines of a minimum of 16 characters each.

5. Programming and display features language: English.

6. Capable of displaying the following parameters:
    a. Speed (percent).
    b. Output current (Amperes).
    c. Output frequency (Hertz).
    d. Input voltage.
    e. Output voltage.
    f. Total 3-phase kilowatt.
    g. Kilowatt hour meter.
    h. Elapsed run time meter.
    i. Revolutions per minute.
    j. Direct current bus voltage.
7. In addition to all keys required for programming, provide the following controls on the keypad:
    a. Local/Remote selector.
    b. Start pushbutton.
    c. Stop pushbutton.
    d. Speed increment.
    e. Speed decrement.
    f. Run LED indicator.
    g. Program LED indicator.
    h. Fault LED indicator.
    i. As required by specific control strategy, and control schematic, and shown on Contract Drawings.

E. Control power transformer:
1. Furnish a control power transformer mounted and wired inside the panel.
2. Primary and secondary fusing.
3. Size the transformer to supply power to all VFD controls and options as well as any external devices indicated on the Drawings including the motor winding heater.

2.04 ACCESSORIES

A. Metal oxide varistors:
1. Provide protection for the VFD against:
    a. Line transients: 5,000 volt peak minimum.
    b. Line to ground transients: 7,000 peak minimum.

B. Conformal coating:

1. Provide conformal coating material applied to electronic circuitry and printed circuit boards to act as protection against moisture, dust, temperature extremes, and chemicals such as H_2S and chlorine.

C. Air filters:

1. Mounted on the outside of the VFD enclosure. Located on the front or top of the VFD enclosure. Side or rear mounted air filters are not acceptable.

2. Replaceable without requiring that the VFD be turned off or the door opened.

2.05 FINISHES

A. Enclosure finish shall be ANSI 61, or vendor standard panel color as approved during submittal process.

2.06 SOURCE QUALITY CONTROL

A. VFD Panel Factory Testing:

1. General:

a. Incoming inspection of components and raw materials based on supplier base and experience.

b. All VFDs furnished under this Section shall be tested and inspected as specified below. Testing of VFDs based on sampling plans is not allowed.

c. The testing procedures specified are the minimum acceptable requirements. The manufacturer may perform additional tests at its discretion.

d. Test communication network. Verify operation from networked commands and feedback.

2. Failure of any component during testing requires repair of the faulted component and complete retest.

3. Testing sequence:

a. Submit a detailed test procedure for the VFD factory test:

1) No tests shall be performed until the test procedure is reviewed and accepted by the ENGINEER.

4. Component tests:

a. Preliminary inspection:

1) Verify that all components are correct.

2) Verify that all connections are properly torqued.

b. Printed circuit boards:

1) Test for correct component placement and value and complete board functional test to ensure proper performance with specified tolerances.

2) Heat cycle test for 48 hours at 60 degrees Celsius.

3) Apply control power to microprocessors, printed circuit boards, diagnostic boards, and similar devices including software to test for proper operation, sequencing, logic, and diagnostics.

4) Test operation of all analog and discrete inputs and outputs.

c. Wiring:

1) Control and power wiring continuity verified point-to-point.

2) Hi-pot power and control wiring at manufacturer's recommended levels.

3) Verify ground bond resistance.

d. Load testing:

1) No load testing in accordance with the manufacturer's standard factory test procedure.

2) Full load testing:

a) Test each VFD and a representative motor with the system logic and a dynamometer load to simulate field operation conditions at 25 percent, 50 percent, and 100 percent full load current.

b) Load test each VFD at an ambient temperature of 50 degrees Celsius.

(1) Monitor and record temperature rise.

(2) Once temperature rise stops continue to operate the VFD for a minimum of 2 hours.

(a) If operating temperature exceeds the rated value, repair or replace the VFD and retest.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Install the VFD Panel per the supplier's guidelines and submitted installation instructions to meet the seismic requirements at the Project Site.

C. General:

1. Furnish all cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories needed to complete installation of the VFD Panel.

2. Install the VFD Panel in the location indicated on the Drawings.

3. Furnish components, and equipment as required to complete the installation.

4. Replace any hardware lost or damaged during the installation or handling to provide a complete installation.

5. Install free-standing enclosures on 3-1/2-inch raised concrete housekeeping pad:

   a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.

   b. Weld and/or bolt the VFD frame to the leveling channels.

6. Provide openings in top or bottom of the VFD (free-standing or within motor control center) enclosure for conduit only, no additional openings will be allowed:

   a. Improperly cut holes will require that the entire panel be replaced:

      1) No hole closers or patches will be allowed.

7. Bundle circuits together and terminate in each unit:

   a. Tie with nylon wire ties. As specified in Section 16123.

   b. Label all wires at each end with wire numbers shown on the approved Control Drawings.

   c. All connections to and from the VFD (free-standing or within motor control center) enclosure must be made via terminal blocks.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Provide the services of a VFD panel supplier representative for start-up assistance and training:

1. Inspection and field adjustment:

   a. Supervise the following and submit written certification that the equipment and controls have been properly installed, aligned, adjusted, and readied for operation.

2. Start-up field testing:

   a. Provide technical direction for testing, checkout, and startup of the VFD equipment in the field.

   b. Under no circumstances are any portions of the drive system to be energized without authorization from the supplier's representative.

   c. Provide complete communications test for failures on network to communication interface modules. These modules must use Modicon standards. Modules shall contain a web page that displays errors, transmit timeouts, missed packets and collision errors. Modules must be factory tested and reports submitted.

   d. Compliance with the following specified parameters shall be verified by the VFD manufacturer:

      1) Power factor:

a) Make field measurements at the input terminals of the VFD with and without the VFD in operation.

b) Make measurements at 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of rated speed and rated power.

c) Measurements shall be made with a recording type power factor meter.

2) Efficiency:

a) Make field measurements at the input terminals of the VFD.

b) Make measurements at rated speed and rated power.

c) Make measurements with a recording type kilowatt hour meter.

3) Motor terminal voltage:

a) Make field measurements at the motor connection box.

b) Make measurements of the full speed range of the VFD.

c) Make measurements with a recording type oscilloscope.

4) Harmonics:

a) Make field measurements at the input terminals of the VFD with and without the VFD in operation.

b) Make measurements at rated speed and rated power.

c) Make measurements with a recording type harmonic analyzer displaying individual and total harmonic currents and voltages:

(1) Record currents and voltages for a minimum of 10 minutes.

(2) Analyzers using snapshots are not acceptable.

C. Provide field acceptance testing per Section 16950 and 01750 as part of General Start-Up and Testing Procedures.

3.03 ADJUSTING

A. Make all adjustments as necessary and recommended by the supplier, ENGINEER, or testing firm.

B. Provide the services of a VFD panel supplier representative to make all drive parameter and protective device settings:

1. Protective device settings provided by the VFD manufacturer in accordance with the manufacturer of the driven equipment requirements.
2. Provide documentation of VFD settings included but not limited to:
    a. Motor data.
    b. Network communication settings.
    c. Minimum speed.
    d. Maximum speed.
    e. Skip speeds.
    f. Current limit.
    g. Acceleration time.
    h. Deceleration time.

3.04 CLEANING

A. As specified in Section 16050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 16050.

B. Demonstrate the operation to the ENGINEER's and OWNER's satisfaction.

C. Training:

1. Provide instruction of the OWNER’s operation and maintenance staff on the operation and maintenance of the VFD.
2. Separate classes are required for the operations staff and maintenance staff:
    a. Operations staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Operations training time is 4 hours (2 classes of 2 hours each):
        1) The sessions shall be scheduled with the OWNER to ensure all operators have the opportunity to attend.
    b. Maintenance staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Maintenance training time is 4 hours (2 classes of 2 hours each):
        1) The sessions shall be scheduled with the OWNER to ensure all maintenance staff has the opportunity to attend.
    c. Instruction shall occur at the OWNER’s facility and shall utilize the actual VFDs installed at the site.
    d. Refer to Section 01750 for further training requirements.

D. Preventive maintenance procedures shall also be demonstrated for Owner personnel during this training period.

3.06 PROTECTION

A. As specified in Section 16050.

END OF SECTION

SECTION 16272

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Enclosed dry-type transformers:

a. Stand-alone units.

b. Units located in motor control centers.

c. Units located in packaged power supply centers.

d. Rated 1 to 1,000 kilovolt-amperes, single and 3-phase.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. As specified in Section 16050.

B. Institute of Electrical and Electronic Engineers (IEEE):

1. C57.12.01 - Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and/or Resin Encapsulated Windings.

2. C57.12.70 - Standard Terminal Markings and Connections for Distribution and Power Transformers.

3. C57.12.80 - Terminology for Power and Distribution Transformers.

C. National Electrical Manufacturers Association (NEMA):

1. TP-1 - 2002 - Guide for Determining Energy Efficiency for Distribution Transformers.
2. TP-2 - Standard Test Method for Measuring the Energy Consumption of Distribution Transformers.
3. TR-1 - Transformers, Regulators, and Reactors.

D. U.S. Department of Energy (DOE):

1. 10 CFR Part 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment.

E. Underwriters Laboratory (UL):

1. 1561 - Standard for Dry-Type General Purpose and Power Transformers.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTIONS

A. Provide 3-phase or 1-phase, 60 hertz dry-type with voltage ratings, kilovolt-ampere capacities, and connections as indicated on the Drawings:

1. Transformers shall provide full capacity at the Project elevation and environmental conditions as specified in Section 16050 after all derating factors have been applied.
2. Suitable for continuous operation at full rating with normal life expectancy as defined in ANSI C57.96.
3. Provide for 50 degree C ambient.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data (primary voltage 600 volts and below):

1. Catalog cut sheets.
2. Nameplate data.
3. Dimensions:
   a. Height.
   b. Width.
   c. Depth.
4. Inrush current.
5. Insulation system and temperature constraints.
6. Number and rating of taps.
7. Sound levels.
8. Connection diagrams:
   a. Primary.

b. Secondary.

9. BIL rating.

10. Required clearances.

11. Percent impedance.

12. Efficiency.

13. Certification of full capacity capability at the Project elevation and ambient conditions.

C. Installation instructions:

1. Provide anchorage instructions and requirements for the transformer based on the seismic requirements at the Project Site as specified in Section 16050.

2. Drawings and calculations stamped and signed by a professional engineer registered in the state where the Project is located.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 WARRANTY

A. As specified in Section 16050.

1.10 SYSTEM STARTUP

A. As specified in Section 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. General Electric.

2. Square D.

3. Eaton.

2.02 MATERIALS

A. Cores:

1. Non-aging, grain-oriented silicon steel.

2. Magnetic flux densities below the saturation point.

B. Windings:

1. High-grade magnet wire.
2. Impregnated assembly with non-hydroscopic, thermo-setting varnish:
   a. Cured to reduce hot-spots and seal out moisture.
3. Material electrical grade:
   a. Copper.

2.03 EQUIPMENT

A. General:

1. 10 kilovolts BIL for 600-volt class windings.
2. Sound levels, under ANSI Standard C89 test conditions, not to exceed:

Kilovolt-Amperes Range	Audible Sound Level (db)
1-9	40
10-50	45
51-150	50
151-300	55
301-500	60
501-700	62
701-1,000	64

3. Taps:
   a. 15 kilovolt-amperes and less:
      1) Two 5 percent full capacity primary taps below rated voltage.
   b. 25 kilovolt-amperes and larger:
      1) Four 2.5 percent full capacity primary taps below rated voltage.
      2) Two 2.5 percent full capacity primary taps above rated voltage.
   c. Operated by a tap changer handle or tap jumpers accessible through a panel.
4. Terminals:
   a. UL listed for either copper or aluminum conductors.
   b. Rated for 75 degrees Celsius.
5. Daily overload capacities, at rated voltage and without reduction in life, in accordance with the loading guide as published in ANSI C57.96.

B. Transformers less than 15 kilovolt-amperes:

1. Insulation class: 185 degrees Celsius.

2. Temperature rise: 115 degrees Celsius.

C. Energy efficient transformers 15 kilovolt-amperes and larger:

1. Insulation class: 220 degrees Celsius.

2. Temperature rise: 80 degrees Celsius, except as noted below:

a. 150-degree Celsius rise for dry-type transformers located in motor control centers.

3. Efficiency:

a. In accordance with NEMA TP-1.

b. Measured by NEMA TP-2.

D. Enclosures:

1. Heavy gauge steel:

a. Outdoor, Wet or Damp environments: Moisture and water resistant with rodent screens over all openings and in a weather-protected enclosure, NEMA Type 3R.

b. Indoor Clean and Dry environment: NEMA Type 2.

2. Louvers to limit coil temperature rise to the value stated above, and case temperature rise to 50 degrees Celsius.

3. Built-in vibration dampeners to isolate the core and coils from the enclosure:

a. Neoprene vibration pads and sleeves.

2.04 ACCESSORIES

A. Nameplates:

1. Non-corrosive metal or UL listed non-metallic:

a. Stamped, engraved or printed with the following information:

1) Phases.

2) Frequency.

3) Kilovolt-ampere rating.

4) Voltage ratings.

5) Temperature rise.

6) Impedance.

7) Insulation class.

8) BIL rating.

9) Connection diagram.

10) Weight.

11) Manufacturer.

12) The identification “transformer.”

13) Classes of cooling.

14) Tap voltage(s).

15) Vector diagram.

2.05 FINISHES

A. Finish to consist of de-greasing, phosphate cleaning, and an electrodeposited ANSI 61 enamel rust-inhibiting paint.

2.06 SOURCE QUALITY CONTROL

A. Factory tests (primary voltage 600 volts and below):

1. Applied voltage test to each winding and from each winding to the core:

a. 600-volt class winding 4.5 kilovolt.

2. Induced voltage test at 2 times normal voltage and 400 hertz for 1,080 cycles.

3. Voltage ratio and polarity.

4. Sound level, performed in a test room with ambient sound level not exceeding 24 db.

5. Perform all tests in accordance with UL 1561.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. General:

1. Floor, wall, platform, motor control center, packaged power supply, or roof mounted, as indicated on the Drawings.

2. Locate where not in direct contact with building structure.

3. Install on vibration isolation pad, ½” thick minimum, selected for maximum isolation.

a. Manufactured by Korfund Dynamics Korpad, or equal.

4. Make any necessary connections to the enclosure with liquidtight flexible conduit having neoprene gaskets and insulated ground bushings.

5. Ground the enclosure:

a. To an equipment ground conductor in the conduit.

b. To the facility grounding electrode system.

6. Floor mounted transformers:

a. Install transformers on 3-1/2-inch housekeeping pads.

b. Install transformers with adequate space from walls or other enclosures for proper ventilation in accordance with the manufacturer's recommendations.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Label all transformers with nameplates per Section 16075.

3.03 ADJUSTING

A. Set the transformer taps as required to obtain nominal output voltage on the secondary terminals.

3.04 CLEANING

A. As specified in Section 16050.

3.05 PROTECTION

A. As specified in Section 16050.

END OF SECTION

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SECTION 16285

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. High-energy surge protective devices.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 01750 – Testing, Training and Facility Startup.

c. Section 16050 - Common Work Results for Electrical.

d. Section 16950 - Field Electrical Acceptance Tests.

1.02 REFERENCES

A. As specified in Section 16050.

B. Institute of Electrical and Electronics Engineers (IEEE):

1. C62.41 - Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.

2. C62.45 - Guide on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.

3. C62.62 - Standard Test Specifications for Surge Protective Devices for Low Voltage AC Power Circuits.

C. Underwriters Laboratory:

1. UL 1449, 3rd Edition, Standard for Surge Protective Devices.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions:

1. SPD: Surge protective device.
2. SAD: Silicon avalanche diode.
3. MOV: Metal oxide varistor.
4. MCOV: Maximum continuous operating voltage.
5. I_n: Nominal discharge current.
6. VPR: Voltage protection rating.
7. SCCR: Short circuit current rating.

1.04 SYSTEM DESCRIPTION

A. Surge protective devices as an integral component of the electrical equipment or externally mounted as indicated on the Drawings.

B. Provide hardwired alarm status to local PLC Panel.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Furnish complete product data confirming detailed compliance or exception statements to all provisions of this Section.
2. Manufacturer's catalog cut sheets indicating:
   a. Manufacturer and model numbers.
   b. Ratings of each SPD including but not limited to:
      1) Short circuit current rating.
      2) Nominal discharge current.
      3) Maximum continuous operating voltage.
      4) Voltage protection rating.
      5) System voltage.
      6) System frequency.
      7) Surge current capacity.
3. Submit independent test data from a nationally recognized testing laboratory verifying the following:
   a. Overcurrent protection.
   b. UL 1449.

C. Shop drawings:

1. Provide electrical and mechanical drawings by the manufacturer that detail:
   a. Unit dimensions.
   b. Weights.

c. Components.

d. Field connection locations.

e. Mounting provisions.

f. Connection details.

g. Wiring diagram.

D. Operation and maintenance manuals:

1. Provide the manufacturer's manual with installation, start-up, spare parts lists, and operating instructions for the specified system.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Provide SPD units that are designed, manufactured, tested and installed in compliance with the following codes and standards:

1. Institute of Electrical and Electronic Engineers (IEEE C62.41, C62.45, C62.62).

2. Federal Information Processing Standards Publication 94 (FIBS PUB 94).

3. National Electrical Manufacturer Association.

4. National Fire Protection Association (NFPA 20, 75 and 780).

5. National Electric Code (NFPA 70).

6. Underwriters Laboratories (UL 1449 3rd Edition and UL 1283).

7. International Electrotechnical Commission (IEC 801).

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SEQUENCING

A. Coordinate with and provide SPD equipment to the electrical equipment manufacturer before final assembly and factory testing.

1.10 WARRANTY

A. As specified in Section 16050.

B. Extended warranty:

1. Furnish a manufacturer's full 5-year parts and labor warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national, state, or local electrical codes.

2. Warranty shall include:

a. Direct, factory trained employees must be available within 48 hours for assessment of the problem.

b. A 24-hour toll-free 800-number for warranty support.

1.11 SYSTEM STARTUP

A. As specified in Section 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Liebert.

2. Eaton.

3. Square D.

4. General Electric.

2.02 MANUFACTURED UNITS

A. Provide Type 1 or Type 2 SPD units as required for the locations indicated on the Drawings.

B. Electrical requirements:

1. SPD ratings are to be consistent with the nominal system operating voltage, phase, and configuration as indicated on the Drawings.

2. MCOV:

a. For the SPD and all components in the suppression path (including all MOVs, SADs, and selenium cells): Greater than 115 percent of the nominal system operating voltage.

3. Operating frequency:

a. 47 to 63 hertz.

4. SCCR:

a. 65 kAIC minimum, but not less than the equipment it is connected to as indicated on the Drawings.

b. The SCCR shall be marked on the SPD in accordance with UL 1449 and the NEC.

5. Nominal discharge current I_n:

a. 20 kA.

6. Maximum VPR:

Modes	240/120	208Y/120	480Y/277
L-N, L-G, N-G	900	900	1,500
L-L	1,200	1,200	2000

7. Peak surge current:
   a. Service entrance locations:
      1) 240 kA per phase minimum.
      2) 120 kA per mode minimum.
   b. Branch locations:
      1) 120 kA per phase, minimum.
      2) 60 kA per mode minimum.

C. Protection modes:
   1. Provide SPD protection modes as follows:
      a. Line to Neutral (L-N) where applicable.
      b. Line to Ground (L-G).
      c. Neutral to Ground (N-G), where applicable.

D. Environmental requirements:
   1. Storage temperature:
      a. -40 degrees to +50 degrees Celsius.
   2. Operating temperature:
      a. -0 degrees to +60 Celsius.
   3. Relative humidity:
      a. 5 percent to 95 percent.
   4. Audible noise:
      a. Less than 45 dBa at 5 feet (1.5 m).
   5. Operating altitude:
      a. Zero to 12,000 feet above sea level.

E. Provide surge protective devices that are suitable for application in IEEE C62.41 Category A, B and C3 environments, as tested to IEEE C62.45.

2.03 COMPONENTS

A. Enclosure:
   1. Located in electrical equipment as indicated on the Drawings.

B. Internal connections:

1. Provide low impedance copper plates for intra-unit connections:

a. Attach surge modules using bolted connections to the plates for low impedance connections.

2. Size all connections, conductors, and terminals for the specified surge current capacity.

C. Surge diversion modules:

1. MOV:

a. Where multiple MOVs are used in parallel, utilize computer matched MOVs to within 1 volt variance and tested for manufacturer's defects.

D. Overcurrent protection:

1. Individually fuse all components, including suppression, filtering, and monitoring components:

a. Rated to allow maximum specified nominal discharge current capacity.

b. Overcurrent protection that limits specified surge currents is not acceptable.

E. Connections:

1. Provide terminals to accommodate wire sizes up to #2 AWG.

2.04 ACCESSORIES

A. Unit status indicators:

1. Provide red and green solid-state indicators, with printed labels, on the front cover to redundantly indicate on-line unit status:

a. The absence of the green light and the presence of the red light indicates that surge protection is reduced and service is needed to restore full operation.

b. Indicates the status of protection on each mode or phase.

B. Dry contacts for remote monitoring:

1. Electrically isolated Form C dry contacts (1 A/125 VAC) for remote monitoring of system integrity, and indication of under voltage, phase and/or power loss.

C. Provide an audible alarm which activates under any fault condition.

1. Provide an alarm On/Off switch to silence the alarm.

2. A visible LED will confirm whether alarm is On or Disabled.

3. Locate both switches and the audible alarm on the unit’s front cover.

2.05 SOURCE QUALITY CONTROL

A. Permanently affix surge rating to the SPD.

B. Perform manufacturer's standard factory test.

1. Perform testing in accordance with UL 1449.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Follow the manufacturer's recommended installation practices and comply with all applicable codes.

C. Special techniques:

1. Install the SPD with as short and straight conductors including ground conductor as practically possible:

a. Twist the input conductors together to reduce input conductor inductance.

2. Do not subject SPD to insulation resistance testing.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16950.

B. Testing shall be part of equipment SPD is installed within.

3.03 DEMONSTRATION AND TRAINING

A. Refer to Section 16050.

B. Provide the field services of a factory technician as necessary to supervise/inspect installation, test, and start-up all equipment provided under this specification:

1. Provide all equipment required for testing, start-up and performance verification.

C. The manufacturer shall instruct the OWNER's maintenance staff on the maintenance of the SPDs.

D. Provide classes for Maintenance staff:

1. Maintenance staff training shall consist of 2 identical training classes each consisting of 1 session per day, with each session lasting 2 hours. Total Maintenance training time is 4 hours:

a. The sessions shall be scheduled with the OWNER so that all maintenance staff has the opportunity to attend the training session.

2. Instruction shall occur at the OWNER's facility.

3. Refer to Section 01750 for further training requirements.

3.04 PROTECTION

A. As specified in Section 16050.

END OF SECTION

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SECTION 16290

ELECTRICAL POWER MONITORING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Supply and installation of power monitoring meters including, but not limited to:

   a. Power meters for power monitoring.

   b. Device communication interface hardware for Modbus 485 communication.

   c. Communication wiring.

   d. Current transformers and potential transformers.

   e. Configuration, software, and programming cables.

   f. Ancillary equipment, nameplates.

   g. Start-up services.

   h. Training services.

2. Interconnection of power monitoring meters utilizing Modbus RTU protocol over RS-485 network to the Plant PLC system.

3. Include data from each power monitoring meter to screens configured on HMI panels.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

   a. Section 01330 - Submittal Procedures.

   b. Section 16050 - Common Work Results for Electrical.

   c. Section 16305 - Electrical System Studies.

1.02 REFERENCES

A. Refer to Section 16050.

B. American National Standard Institute (ANSI):

1. The power monitoring meters shall comply with the applicable portions of ANSI/IEEE 802.3.

2. Meters shall have certified revenue accuracy per ANSI C12.20 and IEC 60687 Class 0.5S or better.

1.03 DEFINITIONS

A. Refer to Section 16050.

B. Specific Definitions:

1. EPMS - Electrical Power Monitoring System.

2. FS - Full Scale.

3. PLC - Programmable Logic Control.

4. RDG - % of Reading.

5. SSM - Solid State Multifunction Power Meter.

6. THD - Total Harmonic Distortion.

1.04 SYSTEM DESCRIPTION

A. The power monitoring meters shall be capable of displaying the information from the power distribution devices as identified in the specifications and/or as indicated on the Drawings or detailed in the individual equipment specifications.

B. The power monitoring meters shall communicate with the PLCs via Modbus 485 communication protocol. PLCs shall capture information from the power monitoring meters.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 16050.

B. Product Data:

1. System description including an overview of the system provided with detailed description of system architecture, system noise immunity, and data provided.

a. Bill of Material including a complete listing of all hardware, software.

2. Block diagram depicting information including but not limited to:

a. Assemblies/Devices to be connected to the system.

b. Types of wiring within equipment for communication network to PLC (RS-485).

3. Narrative detailing the training and start-up services being supplied.

4. Hardware description shall be provided in detail for all communications hardware, including sensor devices gathering data to be transmitted over the network.

5. Detailed information including but not limited to:

   a. Communication cable.

   b. Cable ratings.

   c. Communication characteristics.

   d. Termination requirements.

   e. Splicing/connections requirements.

C. Shop Drawings:

1. Detailed wiring diagrams with wire numbers showing all interconnections within and between the electrical equipment housing the power monitoring equipment.

2. Detailed communication wiring diagrams providing configured addresses.

3. Cable routing.

D. Operation and Maintenance Manuals:

1. System description overview for the complete system, descriptive and technical bulletins and sales aids edited to reflect only the equipment to be provided and covering each of the components in the system.

2. A maintenance section including all instruction leaflets and technical data necessary to setup, change setup and maintain the communicating devices and sensors.

3. A detailed start-up report, including a list of individuals who attended system training shall be provided.

E. Record Documents:

1. Detailed record drawings concerning communication wiring shall include but not be limited to:

   a. System overview with descriptive manuals covering each component within the system.

   b. Maintenance section including instruction and technical data necessary to setup and modify equipment and communications.

   c. Communications sections shall include as a minimum:

      1) Type of communication wire utilized.

      2) General cable ratings and communications characteristics and addressing.

      3) Cable routing diagram including terminations, and splicing connections made.

1.06 QUALITY ASSURANCE

A. Refer to Section 16050.

B. Qualifications:

1. The manufacturer of the equipment shall have been regularly engaged in the manufacture of the specified devices for a period of at least 5 years and demonstrate that these products have been in satisfactory use in functioning systems for similar design, application, installation, and start-up.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. Refer to Section 16050.

1.09 WARRANTY

A. Refer to Section 16050.

1.10 SYSTEM START-UP

A. Refer to Sections 16050 and 16950.

1.11 MAINTENANCE

A. Spare parts shall include but not be limited to:

1. One GE Multilin PQM II-T20-C-A power quality monitor complete.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Electrical Power Monitoring equipment:

1. One of the following, no equal:

a. GE Multilin PQM II.

2.02 COMPONENTS

A. Power Monitoring Meter:

1. Power monitoring meter shall include at a minimum:

a. Individual phase currents, plus or minus 0.2 percent FS.

b. Phase-to-phase and phase-to-neutral voltages, plus or minus 0.2 percent FS.

c. Watts, VARs, VA, plus or minus 0.4 percent FS.

d. Watt-Hours 0.5 percent OR; VAR-Hours 1 percent OR; VA-Hours 0.5 percent OR;

e. PF Apparent 1 percent FS.

f. Frequency, 0.02 Hz.

g. THD:

1) Voltage - plus or minus 2.0 percent.

2) Current - plus or minus 2.0 percent.

h. Demand:

1) Ampere, plus or minus 0.2 percent FS.

2) Watt, VAR, VA, plus or minus 0.4 percent FS.

i. Revenue accuracy, plus or minus 0.2 percent FS.

j. Minimum and Maximum Values:

1) Volts (L-L), Volts (L-N), Current (L, N, G), Watts, VARs, VA.

2) PF.

3) Frequency.

4) THD-Amps, THD-Volts.

5) Demand:

a) Ampere, Watt, VAR, VA.

k. Event Logging:

1) 150 Events with time stamp.

l. Disturbance Recording:

1) 500 Events.

m. Inputs/Outputs:

1) Four Form C relays, rated 10 amps.

2) Four 0-10/4-20 mA analog outputs.

3) Three +30 VDC differential discrete inputs.

4) One 0-20/4-20 mA analog input.

n. Communication: Modbus 485

o. Provide two sets of configuration software and programming cables.

p. Manufacturer, no equal:

1) GE Multilin PQM II-T20-C-A.

2.03 ACCESSORIES

A. Current Transformers:

1. Ring type current transformers:

a. Suitable for service within low or medium voltage switchgear as indicated on the Drawings.

b. Designed to have a mechanical and thermal rating to withstand short-circuit current, stresses, and heating effects equal to the rating of the circuit breaker of the application.

2. Current ratio: As indicated on the Drawings, for use as a guideline:

   a. It is the Switchboard manufacturer's responsibility to size the current transformers to ensure that they will not saturate under the maximum available fault current at the installed location based upon the fault current study as preformed under Section 16305.

3. Rated in accordance with ANSI Standard C57.13 with accuracy of the current transformers suitable for relay accuracy class and rated for 200 percent burden for the required connected devices.

4. Identify polarity with standard marking or symbols.

5. Capable of carrying rated primary current continuously without damage.

6. Install secondary wiring from current transformers in a suitable wiring trough, or conduit to proper short-circuiting type terminal blocks for connection to relays, instruments, and other devices.

7. Located behind the breaker compartment mechanical safety shutter and shall be front accessible once the safety shutter is removed.

B. Potential Transformers:

1. Indoor dry type, single-phase, 60 hertz, with a minimum thermal capacity of not less than 400 volt-amperes at 55 Celsius rise above 40 Celsius ambient.

2. Accuracy classification determined according to ANSI Standard C57.13, suitable for relay accuracy class, and 200 percent burden, for the required connected devices, with the secondary voltage 120 volts.

3. Insulation levels as required for the switchgear system voltage but not less then:

   a. 600 VAC, 10 kV BIL for 480 VAC systems.

4. Identify polarity with standard markings or symbols.

5. Connect transformer secondary to potential buses as required.

6. Protect low voltage potential transformers on the primary side and secondary side with current-limiting fuses.

2.04 SOURCE QUALITY CONTROL

A. Factory Testing:

1. The power monitoring meters shall be fully configured and tested with all actual devices furnished at the manufacturer's facility for each individual piece of electrical equipment.

B. Standard factory tests shall include, but not be limited to:

1. Configure monitoring equipment.

2. Configure communication addressing including appropriate Modbus RTU addresses.

3. Demonstrate communication functionality.

4. Demonstrate system functionality.

5. Inject current and apply appropriate voltages to confirm operation and accuracies.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Section 16050.

B. The CONTRACTOR shall furnish, install, and terminate all communication conductors and associated conduits external to any factory supplied equipment.

C. All communications conductor wiring and routing shall be per the manufacturer's recommendations and as shown on the submittal drawings.

D. CONTRACTOR shall provide and install miscellaneous equipment, interfaces and cables, etc. for operable system. Provide all configurations and programming; including any software updates, adding data points, registers, historical tracks, graphical screens, etc. for a complete and operable system. Coordinate with OWNER.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 16050.

B. Furnish the services of a manufacturer's field engineer to assist in the starting-up and configuration of the power monitoring meters:

1. The manufacturer's representative shall be factory-trained and shall have a thorough knowledge of the software, hardware, and system programming.

2. The manufacturer's representative shall provide the following services:

a. Verifying the setting of all the addresses for all devices in the equipment.

b. Verifying and troubleshooting the integrity of the communications line.

c. Assisting in correcting any communication line problems.

d. Coordinate with OWNER to establish power monitoring meters to Plant PLC communications, and validate data, ranges.

3. Verify complete system operation including all hardware, software, and communication devices.

4. All testing shall be part of General Start-Up and Testing Procedures as outlined in Section 01750.

C. Certification:

1. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted, and tested in accordance with the manufacturer's recommendations.

3.03 CLEANING

A. Refer to Section 16050.

3.04 DEMONSTRATION AND TRAINING

A. Refer to Section 16050.

B. Training:

1. Furnish the services of a manufacturer's representative for a period of two 2-hour days to train the OWNER's personnel in operation and configuration of the system. Total of four hours of training covered over two days.

2. The manufacturer's representative shall be factory-trained and shall have a thorough knowledge of the software, hardware, and system programming.

3. Each training session shall be provided for approximately 5 people and shall include:

a. Hands-on training of site personnel.

b. Explanation of system operation.

c. Explanation of devices.

d. Explanation of the system as installed.

e. Detailed power monitoring meter's software configuration training including:

4. Instruction shall occur at the OWNER's facility.

5. Refer to Section 01750 for further training requirements.

3.05 PROTECTION

A. Refer to Section 16050.

END OF SECTION

SECTION 16305

ELECTRICAL SYSTEM STUDIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Short circuit fault analysis study.
2. Protective device coordination study.
3. Arc-flash hazard study.
4. Harmonic analysis.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. As specified in Section 16050.

B. Institute of Electrical and Electronics Engineers (IEEE):

1. 141 - IEEE Recommended Practice for Electric Power Distribution for Industrial Plants (Red Book).
2. 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
3. 315 - IEEE Standards Electrical and Electronics Graphic and Letter Symbols and Reference Designations.
4. 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book).
5. 519 - IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.

6. 902 - IEEE Guide for Maintenance, Operation and Safety on Industrial and Commercial Power Systems (Yellow Book).

7. 1015 - IEEE Recommended Practice For Applying Low Voltage Circuit Breakers Used in Industrial and Commercial Power Systems - Corrigendum 1 (Blue Book).

8. 1584 - IEEE Guide for Performing Arc Flash Hazard Calculations.

C. National Fire Protection Association (NFPA):

1. 70E - Standard for Electrical Safety in the Workplace.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. General study requirements:

1. Scope:

a. Provide for short-circuit fault analysis, protective device coordination, arc-flash hazard and harmonic studies.

b. The studies shall include suggestions for breaker and relay settings to minimize available arc-flash energy while maintaining device coordination and protection. The studies shall include suggestions for operational parameters to minimize available arc-flash energy.

c. Studies shall account for magnetizing current from all transformers.

d. The electrical system studies shall include all new, modified and existing equipment in the power distribution system including but not limited to:

1) Utility equipment.

2) Switchboards.

3) Transformers:

a) Including all dry-type transformers.

4) Motor control centers.

5) Low voltage free standing variable frequency drives and starters.

6) Disconnect switches.

7) Low voltage motors.

8) Panelboards:

a) Including all 240 and 208 volt systems.

9) Vendor control panels.

10) HVAC equipment.

11) All electrical equipment.

e. Study scenarios:

1) The studies shall include all possible electrical system configurations, for example:

a) Operation on normal (utility) source.

b) ARM switch enabled on utility source.

c) Operation on alternate (utility substation) source.

d) Operation on portable 800KW generator. City will provide generator model and serial number. Contractor shall obtain generator X/R and other data from manufacturer.

2. Obtain, for all equipment, the required data for preparation of the study, including, but not limited to:

a. Transformer kilovolt-ampere (kVA) and impedances.

b. Generator impedances.

c. Generator decrement curves.

d. Generator overload curve.

e. Bus withstand ratings.

f. Cable and bus data.

g. Protective device taps, time dials, instantaneous pickups, and time delay settings.

3. Obtain the Electric Utility information on the normal and alternate available fault current, normal and alternate utility impedances, utility protective device settings including manufacturer and model number, interrupting ratings, X/R ratios, and model information one level above the point of connection:

a. Utility tolerances and voltage variations.

4. The individual performing the studies shall visit the site and collect all necessary field data in order to perform and complete comprehensive electrical system studies.

5. Obtain equipment layouts and configurations from the manufacturer's final submittal requirements and project layout drawings as required.

6. Bus and conductor data:

a. Use impedances of the actual installed or specified conductors, unless otherwise indicated.

b. Use cable and bus impedances calculated at 25 degrees Celsius, unless otherwise indicated.

c. Use 600-volt cable reactance based on typical dimensions of actual installed or specified conductors, unless otherwise indicated.

d. Use bus withstand values for all equipment having buses.

e. Use medium voltage cables reactance based on typical dimensions of shielded cables with 133 percent insulation levels, unless otherwise indicated.

7. Motors:

a. Each motor shall be individually modeled:

1) Grouping of motors for fault contribution current is not acceptable.

b. Motors with variable frequency drives may be assumed to have no contribution to fault current.

8. Use the equipment, bus, and device designations as indicated on the Drawings for all studies.

9. The CONTRACTOR shall provide the OWNER with an electronic copy of the program files used to create the electrical system studies on a CD or DVD.

10. The electrical system studies shall be performed using the latest version of POWER*TOOLS by SKM Systems Analysis, Inc.

11. The CONTRACTOR shall provide the OWNER with a print out of all protective device settings.

12. The CONTRACTOR shall provide the OWNER with a print out of all arc flash labels.

13. The Contractor shall provide the OWNER with a print out of all VFD and RVSS settings and configuration parameters.

B. Short-circuit fault analysis study additional requirements:

1. The short-circuit fault analysis shall be performed and submitted in 2 phases:

a. Initial short-circuit fault analysis:

1) Based on the Contract Documents, Electric Utility information and existing electrical equipment.

2) The initial short-circuit fault analysis report shall indicate the estimated available short-circuit current at the line side terminals of each piece of equipment covered by the scope of the study.

3) Provide a list of assumptions used in the initial study.

b. Final short-circuit analysis:

1) The final short-circuit fault analysis shall modify the initial analysis as follows:

a) Utilize the actual equipment provided on the project.

b) Utilize conductor lengths based on installation.

2. Calculate 3-phase bolted fault, line-to-line fault, line-to-ground fault, double line-to-ground fault, short-circuit 1/2 cycle momentary symmetrical and asymmetrical RMS, 1-1/2 and 4 cycle, interrupting symmetrical RMS, and

30 cycle steady state short-circuit current values at each piece of equipment in the distribution system.

3. Evaluate bus bracing, short circuit ratings, fuse interrupting capacity and circuit breaker adjusted interrupting capacities against the fault currents, and calculate X/R values:

   a. Identify and document all devices and equipment as either inadequate or acceptable.

   b. Provide separate spreadsheet comparing the rating of the equipment and circuit breakers versus the calculated short circuit faults.

4. Calculate line-to-ground and double line-to-ground momentary short circuit values at all buses having ground fault devices.

5. Provide calculation methods, assumptions, one-line diagrams, and source impedance data, including Utility X/R ratios, typical values, recommendations, and areas of concern.

C. Protective device coordination study additional requirements:

1. Furnish protective device settings for all functions indicated on the Drawings, including, but not limited to:

   a. Current.

   b. Voltage:

      1) Provide settings for all voltage relays based upon actual Utility tolerances and specifications.

   c. Frequency:

      1) Provide settings for all frequency relays based upon actual Utility tolerances and specifications.

   d. Negative sequence.

   e. Reverse power.

   f. Machine protection functions:

      1) Provide settings for all motor protective relays based on the manufacturer's recommended protection requirements.

2. Provide log-log form time-current curves (TCCs) graphically indicating the coordination proposed for the system:

   a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular TCC:

      1) Typical time-current curves for identical portions of the system, such as motor circuits, are acceptable as allowed by the ENGINEER.

   b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics:

      1) These details can be included on the TCC.

c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings:

1) These details can be included in the TCC.

3. TCCs shall include all equipment in the power distribution system where required to demonstrate coordination. Include Utility relay and fuse characteristics, medium voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, and motor characteristics, and characteristics of other system load protective devices:

a. Include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, main breaker in branch panelboards and fused disconnect switches.

b. Provide ground fault TCCs with all adjustable settings for ground fault protective devices.

c. Include manufacturing tolerances and damage bands in plotted fuse and circuit breaker characteristics.

d. On the TCCs show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters and transformer damage curves.

e. Cable damage curves.

f. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed based on the short-circuit fault analysis study.

g. Coordinate time interval medium-voltage relay characteristics with upstream and downstream device to avoid nuisance tripping.

4. Suggest modifications or additions to equipment rating or settings in a tabulated form.

5. Provide all settings for protective relays, and adjustable trips on low voltage systems.

D. Arc-flash hazard study additional requirements:

1. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:

a. Perform study with 15 percent arcing fault variation as defined by IEEE 1584.

b. Perform arc-flash calculations at normal and alternate utility fault contributions.

c. Perform arc-flash calculations for both the line side and load side of switchboard, motor control center, external motor starter panels and panelboard main breakers.

d. Perform arc-flash calculations for all short-circuit scenarios with all motors on for 3 to 5 cycles and with all motors off.

e. Protective device clearing time shall be limited to 2 seconds, maximum.

f. Summarize information in spreadsheet format.

g. Calculate boundary for:

1) Arc flash protection

2) Limited shock approach

3) Restricted shock approach

2. Provide executive summary of the study results.

a. Provide summary based upon worst case results.

b. Document method of calculation.

3. Provide a detailed written discussion and explanation of the tabulated outputs.

a. Include all scenarios.

4. Provide all arc flash labels with inscriptions.

5. Provide alternative device settings to allow the OWNER to select the desired functionality of the system:

a. Minimize the arc-flash energy by selective trip and time settings for equipment maintenance purposes while maintaining coordination and protection.

b. Identify the arc-flash energy based upon the criteria of maintaining coordination and selectivity of the protective devices.

6. Provide protective device settings that minimize the incident energy while maintaining proper coordination.

E. Electrical system study meetings:

1. The individual conducting the short circuit analysis, protective device coordination, and the arc-flash hazard studies shall meet with the OWNER and ENGINEER 3 times.

2. The purpose of the 3 meetings is as follows:

a. Initial meeting:

1) Meet with the OWNER and ENGINEER to discuss the scope of the studies.

2) Discuss the OWNER's operational requirements for both normal operation and maintenance.

b. Preliminary results meeting:

1) This meeting will be held after the studies have been completed, reviewed, and accepted by the ENGINEER.

2) The purpose of this meeting is to inform the OWNER of the results of the study and impacts on normal operation and maintenance including:

a) Protective device coordination problems and recommended solutions.

b) Explanation of the arc-flash study results and its potential impact on operations.

c) Recommendations for reduction of arc-flash category levels including reduction of protective device settings or changes in operational practices.

c. Final meeting:

1) Discuss changes to the reports based on the previous meeting.

2) Discuss with the OWNER how changes to the electrical system may change the arc-flash hazard category.

3) Deliver the final electrical system studies report.

3. The meetings will be at the OWNER's facility:

a. Provide a minimum of 3 weeks' notice to the OWNER and ENGINEER in advance of the projected meeting date.

b. Submit a draft of the meeting agenda when each meeting is requested.

4. Meeting materials:

a. Prepare and provide the following materials:

1) Meeting agenda. Include at a minimum the scope of the meeting, estimated time length for the meeting and meeting goals.

2) 6 copies of the project one-line diagrams for the initial meeting.

3) 6 copies of the studies of the submitted study.

F. By virtue of the fact that this is a professional study the OWNER reserves the right to modify the requirements of the study to comply with its operational requirements. The protective device coordination study and the arc-flash study shall be modified based on the results of the meetings with the OWNER.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Initial studies and reports of electrical system studies :

1. Include the following in the initial short-circuit current report:

a. List of all devices included in the studies.

b. A description of all operating scenarios.

c. Form and format of arc flash labels.

C. Final studies and reports of electrical system studies:

1. Format and quantity:

a. Provide 6 bound hard paper copies of all final reports.

b. Provide 3 complete sets of electronic files on CD or DVD media, including the electrical system model(s), configuration files, custom libraries, any other files used to perform the studies and produce the reports. Software files shall be POWER*TOOLS by SKM Systems Analysis, Inc.

c. Provide an electronic version of the bound reports in PDF format, 3 copies.

2. Include the sections below in the final report:

a. Copies of correspondence and data obtained from the Electric Utility Company.

b. Letter certifying the inspection and verification of existing equipment.

c. One-line diagrams:

1) The following information shall be included at a minimum:

a) Motor horsepower.

b) Transformer data:

(1) kVA.

(2) Configuration.

c) Cable data:

(1) Insulation.

(2) Size.

(3) Length.

2) One-line diagrams shall be fully legible at 11-inch by 17-inch size.

3) The system one-line diagram shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.

d. Include in the short-circuit fault analysis study:

1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.

2) Normal system connections and those, which result in maximum fault conditions. Calculation of the maximum rms symmetrical three-phase short-circuit current at each significant location in the electrical system.

3) Appropriate motor short-circuit contribution shall be included at the appropriate locations in the system so that the computer calculated values represent the highest short-

circuit current the equipment will be subjected to under fault conditions.

4) A tabular computer printout shall be included which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment.

5) Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short-circuit duties.

6) The study shall include a computer printout of input circuit data including conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.

7) The system one-line diagram shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis. One line drawings with font smaller than 10pt shall be redrawn in AutoCAD, by Contractor on multiple 11” x 17” sheet, including information listed above.

8) Fault current calculations for the cases run including a definition of terms and guide for interpretation of computer software printouts.

9) The computer printout shall identify the maximum available short-circuit current in rms symmetrical amperes and the X/R ratio of the fault current for each bus/branch calculation.

10) A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

e. Protective device coordination study shall include:

1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study. It shall include the determination of settings, ratings, or types for the protective devices supplied. It shall also include any proposed adjustments to existing protective devices to which the supplied devices must coordinate.

2) Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection and service continuity considered to be of equal importance.

3) List all requirements used in the selection and setting criteria for any protective devices.

4) Manufacturer's time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for all new equipment.

5) A sufficient number of computer generated log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters. At least 3 of the copies shall be in color.

6) Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, the short-circuit current availability at the device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.

7) Tabulation of relay, fuse, circuit breaker, and other protective devices in graphical form with a one-line diagram to display area coordination.

8) The study shall include a separate, tabular computer printout containing the suggested device settings of all adjustable overcurrent protective devices, the equipment where the device is located, and the device number corresponding to the device on the system one-line diagram.

9) A computer generated system one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known. A bus shall be placed on the line side of the main breaker and adjacent to this breaker as well as the generator breaker. This one-line diagram shall be legible on 8-1/2" by 11" paper. Provide multiple AutoCAD drawings on 11" by 17" paper as required to meet this requirement.

10) A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for increasing system protection or device coordination.

11) Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination.

12) Report shall also include suggestions to:

    a) Improve coordination between upstream and downstream devices.

b) Reduce fault current clearing times of upstream devices.

c) Identify equipment protection boundary and inrush current conflicts

f. Include in the arc-flash study:

1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.

2) Normal system connections and those, which result in maximum arc-flash conditions.

3) A detailed arc-flash hazard analysis report with computed incident energy levels (Calories per square inches) and flash protection boundary distances at equipment indicated above to insure adequate protection and safety of personnel working in the vicinity of electrical equipment.

4) Arc-flash raw data, calculations, and assumptions.

5) Arc-flash label data:

a) Identifying the content of each label.

b) Identifying the location of each label.

g. Include in the harmonic study:

1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.

2) The total harmonic distortion (THD) at the point of common coupling (PCC) shall be predicted through computer modeling of the distribution system and connected AC drives. PCC shall be considered as the main breaker of all MCCs and switchboards. Contractor shall calculate TDD and THD at each PCC.

3) Contractor shall calculate TDD and THD at each PCC and clearly identify this value in the report. Provide additional calculations to incorporate available fault current and transformer size.

4) Do not exceed harmonic voltage and current distortion limits at PCC for general system applications, as recommended and defined by IEEE 519, unless specified otherwise in contract drawings.

5) If the calculations determine that the harmonic distortion levels are higher than the voltage and current specified, the drive manufacturer shall provide line reactors, isolation transformers, multi-pulse drives or trap filters to meet the intent of IEEE 519 at no additional cost to the Owner.

D. Certification:

1. Submit written certification, sealed, and signed by the professional engineer conducting the study, equipment supplier, and electrical subcontractor stating that the data used in the study is correct.

E. Submit the credentials of the individual(s) performing the study and the individual in responsible charge of the study.

F. The ENGINEER will review all studies and reports. After review, the ENGINEER will make recommendations and/or require changes to be made to the short-circuit analysis, protective device coordination or arc-flash studies. These changes shall be provided as part of the scope of work.

G. Submit course outline for OWNER's training.

H. Exceptions / Clarifications

1. Itemize all exceptions and clarifications to the Contract Documents in a letter (located in the front of the submittal) on company letterhead.

2. Exceptions that are noted in the study, but not listed on the Exceptions/Clarifications letter, will be considered as non-responsive and not accepted as changes to the Contract Documents.

3. All exceptions taken from the Drawings and specifications shall be documented with justifications. When noting the exception, list which Drawings or which Specification Subsection number the exception is taken.

4. Clarification requests shall list which Drawing or Specification Subsection number the clarification is required for.

I. Provide unique page numbers for every sheet in Study. Unique page numbers to be manually placed by Study Company after printout if study report doesn't assign page numbers. Provide hard tab binder section separator on all studies over 20 pages.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Qualifications of the entity responsible for electrical system studies:

1. The studies shall be performed, stamped, and signed by a professional engineer registered in the state where the project is located.

2. A minimum of 5 years' experience in power system analysis is required for the individual in responsible charge of the studies.

3. All electrical system studies shall be performed with the aid of a digital computer program:

a. Point-to-point calculations are not acceptable.

1.07 SEQUENCING

A. Site visit to gather data on the existing facility systems for all studies:

1. Make multiple trips as required to obtain all data for the electrical system studies.

B. It is the Contractor's responsibility to obtain the required information from the Utility Company and vendors necessary for completing the required studies.

C. Submit the initial short-circuit analysis study before submittal of any electrical equipment.

D. Submit the final short-circuit analysis and protective device coordination studies.

E. Initial arc-flash meeting.

F. Submit the arc-flash hazard study.

G. Second arc-flash meeting for preliminary results.

H. Final arc-flash meeting and final reports.

I. Label equipment with approved arc flash labels. This shall be accomplished prior to General Start-Up and Testing Procedures.

J. OWNER's training.

K. All studies shall be updated prior to Project Completion. Utilize characteristics of as-installed equipment and materials. The protective device coordination study shall be submitted and approved prior to start of field breaker tests per Section 16010.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Electrical system study software, no equal or substitutions:

1. POWER*TOOLS by SKM Systems Analysis, Inc.

2.02 COMPONENTS

A. Arc-flash hazard labels:

1. Dimensions:

a. Minimum 5 inches by 3.5 inches.

2. Materials:

a. Polyester with polyvinyl polymer over-laminate.

b. Self-adhesive.

c. Resistant to:

1) UV.

2) Chemicals and common cleaning solvent resistant.

3) Scuffing.

4) Wide temperature changes.

3. Contents:

a. Short-circuit bus & location identification.

b. Calculated incident energy (calories/square centimeter) range.

1) Based on worst case study results.

c. Arc-flash protection boundary.

d. Description of the combined level of personnel protective equipment.

e. Nominal voltage.

f. Engineering report number, revision number and issue date.

g. Labels shall not be hand labeled. Labels shall be submitted for approval. No labels shall be installed without prior approval by Owner or Owner representative.

4. Color scheme:

a. For locations above 40 calories/square centimeter:

1) White label with red “DANGER” strip across the top.

2) Black lettering.

b. For locations below 40 calories/square centimeter:

1) White label with orange “WARNING” strip across the top.

2) Black lettering.

5. Labels shall not be hand labeled.

6. For all areas, Contractor shall post the following:

a. Working distances

b. Shock hazard voltage

c. Shock Approach Boundaries:

1) Limited

2) Restricted

3) Prohibited

7. Labels shall comply with the latest requirements of NFPA 70E.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. After review and acceptance of the arc-flash hazard study by the ENGINEER, install all arc-flash hazard labels:

1. Install labels at all locations required by NFPA, ANSI, or IEEE standards.

2. At a minimum install labels in the following locations:

a. The front of each main or incoming service compartment.

b. The front of each low voltage switchboard section.

c. The front of each medium voltage circuit breaker door.

d. The front of each accessible auxiliary or conductor compartment.

e. Each accessible rear or side vertical section.

f. Each motor control center compartment.

g. Each panelboard covered by the study.

h. Each control panel, individual starter or VFD or other equipment covered by the scope of the study.

i. All electrical equipment with an incident energy level greater than 1.2 Cal/cm2.

3. Install labels prior to equipment energization.

C. After review and acceptance of the arc-flash hazard study and coordination study by the ENGINEER, adjust protective device settings per final study prior to equipment energization.

1. Devices which require power for configuration may be set during energization, but before any sub-fed loads are energized.

2. Ensure that settings for upstream equipment are set prior to energizing downstream devices.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. The individual performing the arc-flash hazard study shall direct the installation of the arc-flash hazard labels:

1. Remove and replace any improperly applied labels.

2. Repair the equipment finish damaged by removal of any label.

3. Install labels to within 1/64 inch of level or plumb across the entire dimension of the label.

C. Reports shall be updated to reflect as-built conditions and the end of the project.

3.03 DEMONSTRATION AND TRAINING

A. As specified in Section 16050.

B. Training:

1. Provide in accordance with Section 01756 and supplemented by the conditions below.

2. Provide a minimum of 3 training sessions for the OWNER's electrical maintenance personnel:

a. Each session shall be a minimum of 4 hours.

3. The training shall cover at a minimum:

a. Hazards associated with arc-flash.

b. Causes of arc-flash.

c. Explanation of the arc-flash labels installed on the OWNER's electrical equipment.

d. Proper use of personal protective equipment.

e. PPE requirements for maintenance work.

f. Operation of Switchboard and HMI Panels.

4. The individual in charge of the arc-flash study or qualified representative shall conduct the training sessions.

5. The sessions shall be scheduled with the OWNER so that all maintenance staff has the opportunity to attend the training session.

END OF SECTION

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SECTION 16411

DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Fusible and non-fusible disconnect switches.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittals.
   b. Section 01750 – Testing, Training and Factory Startup.
   c. Section 16050 - Common Work Results for Electrical.
   d. Section 16075 - Electrical Identification.
   e. Section 16305 - Electrical System Studies.
   f. Section 16494 - Low Voltage Fuses.

1.02 REFERENCES

A. As specified in Section 16050.

B. Underwriters Laboratories Inc. (UL):

1. 20 - General-Use Snap Switches.
2. 98 - Enclosed and Dead-Front Switches.
3. 508 - Standard for Industrial Control Equipment.

C. National Electric Manufacturer's Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment.
2. KS 1-2001- Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions:

1. Safety switches and disconnect switches are to be considered synonymous.

1.04 SYSTEM DESCRIPTION

A. Provide heavy-duty type disconnect switches as indicated on the Drawings and specified in the Contract Documents.

B. Provide disconnect switches with the number of poles, voltage, current, short circuit, and horsepower ratings as required by the load and the power system.

C. Provide a local horsepower rated disconnect switch for each motor unless otherwise indicated on the Drawings.

D. Provide nameplates on all switches per Section 16075.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Manufacturer.

2. Manufacturer's specifications and description.

3. Ratings:

a. Voltage.

b. Current.

c. Horsepower.

d. Short circuit rating.

4. Fused or non-fused.

5. NEMA enclosure type.

6. Dimensions:

a. Height.

b. Width.

c. Depth.

7. Weight.

8. Cross-referenced to the disconnect schedule indicated on the Drawings.

C. Shop drawings:

1. Manufacturer's installation instructions:

a. Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance, Regulatory Requirements below.

b. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.

2. Identify motor or equipment served by each switch; indicate nameplate inscription.

D. Installation instructions:

1. Provide anchorage instructions and requirement based on the seismic requirements at the Project Site as specified in Section 16050 and calculations:

a. Stamped by a professional engineer registered in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Regulatory requirements:

1. NEMA KS1- Enclosed and Miscellaneous Distribution Switches (600 V Maximum).

2. UL 98 - Enclosed and Dead-Front Switches.

C. Disconnect switches shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 16305 and submit results for ENGINEER's review.

B. After successful review of the initial fault current study, as specified in Section 16305, submit complete equipment submittal as specified in the Submittal article of this Section for ENGINEER's review.

1.10 WARRANTY

A. As specified in Section 16050.

1.11 SYSTEM STARTUP

A. As specified in Section 16050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Square D Company.

2. Eaton.

3. General Electric.

4. Siemens.

2.02 EQUIPMENT

A. Switch mechanism:

1. Quick-make, quick-break heavy-duty operating mechanisms:

   a. Provisions for padlocking the switch in the “Off” position.

   b. A minimum of 90-degree handle travel position between Off and On positions:

      1) Provide handle position indicators to identify the handle position.

   c. Full cover interlock to prevent opening of the switch door in the On position and to prevent closing the switch mechanism with the door open:

      1) With an externally operated override.

   d. Provide one normally open contact (closed when disconnect switch is closed), rated 5 amps at 120 VAC.

B. Switch interior:

1. Switch blades visible when the switch is “Off” and the cover is open.

2. Lugs:

   a. Front accessible.

   b. Removable.

   c. UL listed for 60/75-degree Celsius copper conductors.

3. Current carrying parts completely plated to resist corrosion.

4. Removable arc suppressors to facilitate easy access to line side lugs.

5. Furnish equipment ground kits for every switch.

C. Fused switches:

1. Furnish with fuses as indicated on the Drawings:

   a. Provide fuses as specified in Section 16494.

2. UL approved for field conversion from standard Class H fuse spacing to Class J fuse spacing:

   a. Ratings 100 amperes through 600 amperes at 240 volts.

   b. Ratings 30 amperes through 600 amperes at 600 volts.

   c. Provide spring reinforced and plated fuse clips.

D. Ratings:

1. UL horsepower rated for AC or DC with the rating not less than the load served.

2. Current:

   a. 30 to 1,200 amperes.

3. Voltage:

   a. 250 volts AC, DC.

b. 600 volts (30 A to 200 A, 600 volts DC).

4. Poles:

a. 2, 3, 4, and 6 poles.

5. UL listed short circuit ratings:

a. 10,000 RMS symmetrical amperes when used with or protected by Class H or K fuses (30-600 amperes).

b. 200,000 RMS symmetrical amperes when used with or protected by Class R or J fuses (30-600 amperes employing appropriate fuse rejection).

c. 200,000 RMS symmetrical amperes when used with or protected by Class L fuses (800-1,200 amperes).

6. Where not indicated on the Drawings, provide switches with the NEMA ratings specified in Section 16050 for the installed location.

E. Size, fusing and number poles as indicated on the Drawings or as required:

1. Provide solid neutral where indicated on the Drawings.

F. Provide heavy duty pre-wired receptacle disconnect switches for 3-phase, 3-wire, grounded type plugs. Interlock receptacle disconnect switch handle mechanisms so that power plugs may not be inserted or removed when switch is in the On position:

1. 30 to 100 amp fusible, non-fusible, or with circuit breaker as indicated on the Drawings.

2.03 ACCESSORIES

A. Disconnect switches to have provisions for a field installable “B” type electrical interlock (auxiliary contact) for position indication as indicated on the Drawings.

B. Disconnect switches to have provisions for a field installed insulated ground-able neutral kit as indicated on the Drawings.

C. Provide disconnect switches with E-Stop pushbuttons as required by Disconnect Table on Drawings.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Install disconnect switches per the manufacturer’s guidelines and submitted installation instructions to meet the seismic requirements at the Project Site.

C. General:

1. Use Myers hubs or bolt-on hubs for all conduit penetrations on NEMA Type 12, Type 4, and Type 4X enclosures.

2. Provide all mounting brackets, stands, supports and hardware as required:

a. Match finish and materials for all brackets, stands, and hardware with the switch installed.

b. Provide adequate supporting pillar(s) for disconnect switches in accordance with the approved seismic calculations, and locate aboveground or above decks, where there is no structural wall or surface for box.

3. When possible, mount switches rigidly to exposed building structure or equipment structural members:

a. For NEMA Type 4 and Type 4X locations, maintain a minimum of 7/8 inch air space between the enclosure and supporting surface.

b. When mounting on preformed channel, position channel vertically so that water may freely run behind the enclosure.

4. Provide a nameplate for each disconnect switch:

a. Provide per requirements specified in Section 16075.

b. Identify voltage, circuit, fuse size, and equipment served on the nameplate.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050 and Section 01750.

3.03 CLEANING

A. As specified in Section 16050.

3.04 PROTECTION

A. As specified in Section 16050.

END OF SECTION

SECTION 16412

LOW VOLTAGE MOLDED CASE CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Low voltage molded case circuit breakers as indicated on the Drawings and as specified.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 01750 – Testing, Training and Factory Startup.

c. Section 16050 - Common Work Results for Electrical.

d. Section 16305 - Electrical System Studies.

1.02 REFERENCES

A. As specified in Section 16050.

B. National Electrical Manufacturers Association (NEMA):

1. AB 3 - Molded Case Circuit Breakers and Their Application.

C. Underwriter's Laboratories (UL):

1. 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

2. 943 - Ground Fault Circuit Interrupters.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. In accordance with UL 489.

1.04 SYSTEM DESCRIPTION

A. Molded case thermal magnetic or motor circuit protector type circuit breakers as indicated on the Drawings and connected to form a completed system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Catalog cut sheets.

2. Manufacturer's time-current curves for all molded case circuit breakers furnished.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Low voltage molded case circuit breakers shall be UL listed and labeled.

C. Conduct fault current study as specified in Section 16305 and submit results for Engineer's review.

1.07 DELIVERY, STORAGE AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 WARRANTY

A. As specified in Section 16050.

1.10 SYSTEM START UP

A. As specified in Section 16050.

B. Provide all nameplates and schedules as required prior to General Start-Up and Testing Procedures.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Eaton.

2. General Electric Company.

3. Square D Company.

2.02 MANUFACTURED UNITS

A. General:

1. Conforming to UL 489.

2. Operating mechanism:

a. Quick-make, quick-break, non-welding silver alloy contacts.

b. Common Trip, Open and Close for multi-pole breakers such that all poles open and close simultaneously.

c. Mechanically trip free from the handle.

d. Trip indicating handle - automatically assumes a position midway between the manual ON and OFF positions to clearly indicate the circuit breaker has tripped.

e. Lockable in the "OFF" position.

3. Arc extinction:

a. In arc chutes.

4. Voltage and current ratings:

a. Minimum ratings as indicated on the Drawings.

b. Minimum frame size 100A.

5. Interrupting ratings:

a. Minimum ratings as indicated on the Drawings.

b. Modify as required to meet requirements of the short circuit fault analysis - as specified in Section 16305.

c. Not less than the rating of the assembly (panelboard, switchboard, motor control center, etc.).

B. Motor circuit protectors:

1. Instantaneous only circuit breaker as part of a listed combination motor controller.

2. Each pole continuously adjustable in a linear scale with ‘LO’ and ‘HI’ settings factory calibrated.

2.03 COMPONENTS

A. Terminals:

1. Line and load terminals suitable for the conductor type, size, and number of conductors in accordance with UL 489.

B. Case:

1. Molded polyester glass reinforced.

2. Ratings clearly marked.

C. Trip units:

1. Provide thermal magnetic or solid-state trip units as indicated on the Drawings.

2. Thermal magnetic:

a. Instantaneous short circuit protection.

b. Inverse time delay overload.

c. Ambient or enclosure compensated by means of a bimetallic element.

3. Solid state:

a. With the following settings as indicated on the Drawings.

1) Adjustable long time current setting.

2) Adjustable long time delay.

3) Adjustable short time pickup.

4) Adjustable short time delay with option I^2t in, I^2t out.

5) Adjustable instantaneous pickup.

6) Adjustable ground fault pickup as indicated on the Drawings.

7) Adjustable ground fault delay as indicated on the Drawings with option I^2t in, I^2t out.

D. Provide ground fault trip devices as indicated on the Drawings.

E. Molded case circuit breakers for use in panelboards:

1. Bolt-on type.

a. Plug-in type breakers are not acceptable.

2. Ground fault trip devices as indicated on the Drawings.

2.04 SOURCE QUALITY CONTROL

A. Test breakers in accordance with:

1. UL 489.

2. Manufacturer's standard testing procedures.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install breakers to correspond to the accepted shop drawings.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050 and Section 01750.

3.03 ADJUSTING

A. Adjust trip settings in accordance with Protective Device Coordination Study as accepted by the ENGINEER and in accordance with manufacturer's recommendations.

B. Adjust motor circuit protectors in accordance with NEC and the manufacturer's recommendation based on the nameplate values of the installed motor.

3.04 PROTECTION

A. As specified in Section 16050.

END OF SECTION

SECTION 16422

MOTOR STARTERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Motor starters and contactors, installed in:

a. Motor control centers (MCCs).

1) Motor starters shall be intelligent, networked type and communicate to PLC via Modbus TCP network.

b. Vendor Control Panels and other control panels.

c. Enclosed combination starters.

2. Starter types:

a. Magnetic starters.

b. Solid state starters.

c. Contactors.

d. Integral self-protected starters.

e. Manual motor starters.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 01750 - Testing, Training, and Facility Start-Up.

c. Section 16050 - Common Work Results for Electrical.

d. Section 16075 - Electrical Identification.

e. Section 16123 - 600 Volt or Less Wires and Cables.

f. Section 16412 - Low Voltage Molded Case Circuit Breakers.

g. Section 16444 - Low Voltage Motor Control Centers.

h. Section 17710 - Control Systems - Panels, Enclosures, and Panel Components.

1.02 REFERENCES

A. As specified in Section 16050.

B. International Electrotechnical Commission (IEC):

1. 60 947-4 - Low-Voltage Switchgear and Control Gear.

2. 801-1 - Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment - Part 1: General Information.

C. National Electrical Manufacturer's Association (NEMA):

1. ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 V.

D. Underwriters Laboratories (UL):

1. 508 - Standard for Industrial Control Equipment.

2. 508A - Standard for Industrial Control Panels.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions and abbreviations:

1. FVNR: Full voltage non-reversing.

2. FVR: Full voltage reversing.

3. TS1W: 2 speed 1 winding (consequent pole).

4. TS2W: 2 speed 2 winding.

5. PWS: Part winding start.

6. RVSS: Reduced voltage solid state.

7. Overload relay class: A classification of an overload relay time current characteristic by means of a number which designates the maximum time in seconds at which it will operate when carrying a current equal to 600 percent of its current rating.

1.04 SYSTEM DESCRIPTION

A. General requirements:

1. Starters for motor control centers, individual enclosed starters, or control panels.

2. All non-VFD driven motors larger than 35 horsepower shall have RVSS starters.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050:

1. Submit motor starter data with equipment submittal.

B. Product data:

1. Manufacturer.
2. Catalog cut sheets.
3. Technical information.
4. Complete nameplate schedule.
5. Complete bill of material.
6. List of recommended spare parts.
7. Confirmation that the overload relay class for each starter meets the requirements of the equipment and motor supplier.
8. Electrical ratings:
    a. Phase.
    b. Wire.
    c. Voltage.
    d. Ampacity.
    e. Horsepower.
9. Individually enclosed combination starter:
    a. Dimensions:
        1) Height.
        2) Width.
        3) Depth.
        4) Weight.
    b. Enclosure information:
        1) NEMA rating.
        2) Materials.
    c. Furnish circuit breaker submittals as specified in Section 16412.

C. Shop drawings:

1. Elementary and schematic diagrams:
    a. Provide 1 diagram for every starter and contactor. Typical diagrams shall not be accepted.
    b. Indicate wire numbers for all control wires on the diagrams:
        1) Wire numbering as specified in Section 16075.
    c. Indicate interfaces with other equipment on the drawings.
2. Individually enclosed starters:
    a. Layout drawings:
        1) Complete dimensioned component and starter unit layout drawings.

2) Allowable top and bottom conduit windows.

D. Installation instructions:

1. The written instructions must detail the complete installation of the free standing starters including moving and setting into place.

2. Provide anchorage instructions and requirements for the free standing starter based on the seismic requirements at the Project site as specified in Section 16050:

a. Stamped by a professional engineer registered in the state where the Project is being constructed.

E. Operation and maintenance manuals:

1. Submit complete operating and maintenance instructions presenting full details for care and maintenance of equipment furnished or installed under this Section. Including but not limited to:

a. Electrical ratings:

1) Phase.

2) Wire.

3) Voltage.

4) Ampacity.

b. Complete bill of material.

c. Manufacturer's operating and maintenance instructions starter and/or contactor component parts, including:

1) Protective devices (fuses, breakers, overload relays, heater elements, etc.).

2) Pilot devices.

d. Complete renewal parts list.

e. As-built drawings:

1) Furnish as-built drawings for each starter and contactor indicating final:

a) Wire numbers.

b) Interfaces with other equipment.

2) 11-inch by 17-inch format.

F. Certifications:

1. Provide manufacturer's certification that the reduced voltage solid state starter will reliably control the acceleration and deceleration of the driven load at the installed conditions:

a. Failure of the manufacturer to provide said certification will be interpreted to mean that the manufacturer has agreed that the reduced voltage solid state starter is matched to the driven load at the installed conditions and will function without fault.

b. If the reduced voltage solid-state starter fails to perform as desired, replace or modify the reduced voltage solid-state starter in order to achieve the desired operational conditions, as directed by the ENGINEER.

2. Provide manufacturer's certification that all electronic circuits and printed circuit boards are conformally coated.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Only NEMA rated contactors are allowed. IEC rated contactors are not allowed.

C. Regulatory requirements:

1. All starters and components shall be UL listed and labeled:

a. UL 508 - Industrial Control Equipment.

b. UL 508A - Industrial Control Panels.

2. NEMA ICS 2 - Industrial Control and System Controllers; Contactors and Overload Relays Rated: 600 Volts.

3. Combination starters shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SCHEDULING

A. Reduced voltage solid state starters:

1. Submit certification that the RVSS will reliably accelerate and decelerate the driven load at the installed conditions as part of the equipment submittal prior to any testing.

2. RVSS startup and testing by manufacturer after connection to equipment.

3. RVSS training by manufacturer after startup and testing, and before plant commissioning.

1.10 WARRANTY

A. As specified in Section 16050.

1.11 SYSTEM STARTUP

A. As specified in Section 16050.

B. RVSS:

1. Provide the services of the manufacturer's technical representative for start-up, adjustment, and troubleshooting, a minimum of 2 hours per starter at the OWNER'S facility.

1.12 MAINTENANCE

A. Spare parts:

1. Provide the following spare parts, suitably packaged and labeled with the corresponding equipment number:

a. One spare fuse of each size and type per starter.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. NEMA starters and contactors:

a. Allen-Bradley.

b. Square D.

c. General Electric.

d. Eaton.

2. Reduced voltage solid state starters:

a. Allen-Bradley.

b. Eaton.

c. General Electric.

d. Square D.

3. Manual motor starters:

a. Square D.

b. General Electric.

c. Eaton.

4. Integral self-protected starters:

a. Allen-Bradley.

b. Square D - Telemecanique.

c. General Electric - Surion.

d. Eaton.

2.02 MANUFACTURED UNITS

A. General:

1. Motor starters within designated intelligent MCCs shall be networked by MCC manufacturer. Starters shall be controlled and monitored both locally at the MCC and remotely from network connected SCADA system via the PLC Panel. Refer to Contract Drawings for networked data requirements for each starter.

2. Provide combination type starters with motor circuit protector or thermal-magnetic circuit breaker and control power transformer with ratings as indicated on the Drawings, or as required by connected loads.

3. NEMA size, design, and ratings:

   a. As required by connected load, and as shown on Contract Drawings.

   b. NEMA Size 1 minimum:

      1) With the exception of integral self-protected starters.

4. Coordinate motor circuit protector, thermal magnetic circuit breaker, or fusible disconnect, and overload trip ratings with nameplate horsepower and current ratings of the installed motor:

   a. If motors provided are different in horsepower rating than those specified or indicated on the Drawings, provide starters coordinated to the actual motors furnished.

5. Provide starters NEMA Size 2 and larger with arc quenchers on load breaking contacts.

6. Overload reset buttons to be accessible for operation without opening starter enclosure door.

B. Full voltage starters (FVNR, FVR, TS1W, TS2W):

1. Across-the-line full voltage magnetic starters.

2. Rated for 600 volts.

3. Electrical characteristics as indicated on the Drawings.

4. Provide positive, quick-make, quick-break mechanisms, pad lockable enclosure doors.

5. Furnish starter with solid state electronic overload relays.

6. Double-break silver alloy contacts.

7. Reversing starters provided with both mechanical and electrical interlocks to prevent line shorts and energizing both contactors simultaneously.

8. Provide two-speed, two-winding motor starters consisting of two 3-pole contactors and two sets of overload relays assembled together:

   a. Provided with conductors that are both mechanically and electrically interlocked to prevent energizing both contactors simultaneously.

9. Provide two-speed, one winding constant torque starter consisting of one 5-pole and one 3-pole conductor and two sets of overload relays assembled together:

   a. Provided with conductors that are both mechanically and electrically interlocked to prevent energizing both contactors simultaneously.

C. RVSS:

1. Manufactured and tested in accordance with the applicable requirements of IEEE, UL, and NEMA, including the following:

   a. Dielectric withstand per UL 508.

   b. Noise and RF immunity per NEMA ICS-2-230.

2. Furnish with a motor circuit protector or thermal magnetic circuit breaker as indicated on the Drawings.

3. Provide protection against internal faults and high SCR temperature during operation of the motor including starting, running (except when bypassed), and stopping modes.

4. Capable of continuously delivering full rated current of the motor plus the motor service factor in ambient temperatures from 0 degrees Celsius to 50 degrees Celsius at the installed altitude. Refer to Contract Drawings for ampacity requirements of RVSS. Minimum size shall be as required for connected load.

5. Provide a magnetically operated bypass contactor in parallel with the solid state starter:

   a. The bypass contactor to energize when the motor has reached full speed:

      1) The electronic overload protection circuits must be fully functional with the bypass contactor closed.

   b. Provide full speed external bypass contactor where shown on Contract Drawings. Internal bypass contactor shall be provided.

6. RVSS control module requirements:

   a. Microcomputer based, removable, LED display, and contains the required circuitry to drive the power semiconductors in the power section of the starter.

   b. Integrally mounted on the power section and requires no additional panel space or wiring.

   c. Mounted for easy wiring, testing, service, and replacement.

   d. Provide 3-phase current sensing.

   e. Quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs, and SCR gate firing output circuits.

   f. Operates on power supplied from a control power transformer.

   g. Phase insensitive or with phase rotation protection.

   h. Control modes:

      1) Soft start with adjustable linear ramp time and a “kick start” or “boost” feature to provide a short time (typically 0.1 seconds) application of approximately full voltage.

      2) Soft start with adjustable linear ramp time, with a current limit:

a) The current limit shall be adjustable over the range of 2 to 4 times normal full load current.

3) Reverse voltage ramp (line voltage to zero voltage):

a) Adjustable from 2 to 30 seconds to provide smooth stop.

b) Automatic shutdown at end of voltage ramp.

i. Protective functions:

1) Single phase protection.

2) Under voltage protection.

3) Short circuit electronic trip overcurrent protection. Time not to exceed 3 cycles.

4) Inverse time running overcurrent protection.

5) Auxiliary trip circuitry.

6) Gate firing circuit lockout protection on trip.

7) Jam and stall detection.

8) Fault relay lockout protection.

9) 100 percent to 130 percent full load running current trip adjustment.

10) 100 percent to 450 percent of starting current limit adjustment.

11) Dwell time at current limit with ramp continuation after acceleration.

12) Individual light emitting diodes (LEDs) for trip and phase loss.

13) Minimum and maximum initial starting voltage adjustments.

14) Initial torque adjustment.

7. RVSS power section requirements:

a. 3 sets of back-to-back phase controlled power semiconductors:

1) Minimum repetitive peak inverse voltage of 1,500 volts at 480 VAC.

2) Resistor/capacitor snubber networks to prevent false firing of the SCRs.

3) Equipped with individual heat sink assemblies.

4) Provide high-speed fuses for protection of the SCR stacks against short circuit conditions.

b. Provide metal oxide varistors for surge protection on the line [and load] side power terminal connections:

1) Rated for a minimum of 120 joules.

c. Capable of supplying the following current levels:

1) 600 percent of full load current for a minimum of 10 seconds.

2) 450 percent of full load for a minimum of 30 seconds.

d. Furnish ground lugs, one for incoming and one for outgoing ground connections.

e. Furnish pressure type terminals for top or bottom entry power terminations.

8. Remote indicators, RVSS:

a. Provide Form C dry contacts for remote indication of:

1) Overload.

2) System failure alarm statuses including: Drive electronics over temperature, Frequency out of range, Phase loss, Phase reversal, Overvoltage, Undervoltage, Internal fault error.

3) Starter failure alarm statuses including: Excessive starts per hour, Stall, Jam.

4) Run status.

5) Full speed.

9. Metering:

a. 3-phase motor current.

b. Power in kW.

c. Power factor.

d. Three-phase voltage.

e. Power usage in kWh.

10. Provide all software and cables for configuration, uploading and downloading files to Owner.

D. Manual motor starters:

1. General:

a. Provide with number of poles as indicated on the Drawings or as required by the connected load.

b. Provide handles that clearly indicate the On, Off (with lockout), and Tripped positions, and positive, quick-make, quick-break mechanisms.

2. With thermal overload switches:

a. Provide for all single phase motors 1/3 HP and smaller.

b. Size heater elements for approximately 115 percent of the nameplate full load current, for motors with a 1.15 service factor.

c. Thermal overload units in all phase legs.

d. Overload conditions interrupts all ungrounded conductors.

3. Without thermal overload switches:

a. Install only on equipment that requires no external motor overload protection.

4. Enclosure:

a. Provide the enclosure type specified in Section 16050 for the starter location.

E. Integral self-protected starters:

1. IEC rated device consisting of:

a. Circuit breaker.

b. Contactor.

c. Dual-function overload relay.

2. Designed to use the same contacts for contactor and breaker operation:

a. Contactor and breaker operations shall be independent of each other.

3. Ratings: As shown on Contract Drawings.

4. Furnish overload relay modules capable of independently adjustable thermal and magnetic trips:

a. Provide one normally open and one normally closed contact associated with motor overload contact block per starter.

5. Provide surge protection devices across the coil of each magnetic starter.

6. Furnish local status indication.

7. Terminal wiring located behind recessed plastic housing.

8. UL listed and labeled.

2.03 COMPONENTS

A. Molded case circuit breakers:

1. Circuit breaker type and ratings as indicated on the Drawings.

2. Provide as specified in Section 16412.

B. Contactors:

1. NEMA size as indicated on the Drawings.

2. Electrically held:

a. For lighting loads designed to withstand the initial inrush currents of ballast and lamp loads.

3. Factory adjusted and chatter free.

4. Auxiliary contacts:

a. Contact ratings as per NEMA A 600 rating:

1) Auxiliary contacts rated 10 amps at 600 volts.

b. Provide all contacts indicated on the Drawings, and any additional contacts required for proper operation.

c. Provide at least 1 normally open and 1 normally closed spare auxiliary contact.

5. Constructed in accordance with the following standards:

a. UL 508.

b. IEC 947-4.

1) Type 1 coordination when protected by a circuit breaker.

2) Type 2 coordination when protected by a suitable UL listed fuse.

c. IEC 801-1 parts 2 through 6.

C. Overloads:

1. Bi-metallic overload relay:

a. Class 20 protection.

b. Ambient compensated.

c. Interchangeable heater pack:

1) One heater per phase.

2) Coordinate with installed motor full load amps and service factor.

d. Visible trip indicator.

e. Push-to-trip test.

f. Isolated normally open alarm contact.

g. Normally closed trip contacts.

h. Manual reset.

2. Solid state electronic:

a. Selectable Class 10, 20, 30 protection.

b. Ambient insensitive:

1) Operating temperature: -20 to 70 degrees Celsius.

c. Thermal memory.

d. Protective functions:

1) Motor overcurrent.

2) Phase unbalance (adjustable).

3) Phase loss.

4) Ground fault protection.

e. Self-powered.

f. Provide current transformers for metering of motor current.

g. Visible trip indicator.

h. Push-to-trip test.

i. Isolated normally open alarm contact.

j. Normally closed trip contact.

k. Manual reset.

3. Solid state electronic with network communications:

a. Selectable Class 10, 20, 30 protection.

b. Ambient insensitive:

1) Operating temperature: -20 to 70 degrees Celsius.

c. Thermal memory.

d. Protective functions:

1) Motor overcurrent.

2) Phase unbalance (adjustable).

3) Phase loss.

4) Ground fault:

a) Provide zero sequence current transformer where indicated on the Drawings.

5) Bypass Contactor Failure to Close.

e. 120 VAC powered.

f. Provide current transformers for metering of motor current.

g. Visible trip indicator.

h. Push-to-trip test.

i. Isolated normally open alarm contact.

j. Normally closed trip contact.

k. Manual reset.

l. Communications:

1) Manufacturer standard communication protocol within MCC but final network connection to PLC Panel shall be Modbus TCP.

2) Manufacturer shall configure and address all networked starters prior to testing and startup.

D. Control power transformer:

1. Furnish integral control power transformer capacity to power:

a. All motor controls and space heaters as indicated on the Drawings.

b. Motor winding heaters, through a normally closed auxiliary contact on the starter.

2. Primary and secondary fusing as indicated on the Drawings:

a. Fusing sized by the manufacturer for the rating of the transformer furnished.

3. Control power transformer secondary voltage:

a. 120 VAC.

E. Enclosures for individually enclosed starters:

1. NEMA type specified for the location as specified in Section 16050:

a. Where not specified, provide NEMA Type 12 enclosure for indoor dry location, NEMA Type 4X enclosures for outdoor, wet, or corrosive areas, and NEMA Type 7 for Class I, Division 1 or 2 classified areas.

2. Flange-mounted handle mechanism to operate disconnect switch or circuit breaker:

a. Door mounted operators or operator handles are not acceptable.

b. Handle mechanism features:

1) Engaged with the disconnect device at all times as an integral part of the unit independent of the door position.

2) Lockable in the “Off” position.

3) Mechanically interlocked so that the disconnect cannot be switched to the On position with the door open:

a) Provide a means for qualified personnel to defeat this interlock during maintenance and testing.

4) Lockable in the On position:

a) This feature shall not prevent the circuit breaker from operating during a fault condition.

3. Provide a thermostatically controlled space heater for equipment located outdoors or in unheated areas:

a. Powered from the starter or integral control power transformer.

2.04 ACCESSORIES

A. Lugs and terminals:

1. For all external connections of No. 6 AWG and larger.

2. UL listed for either copper or aluminum conductors.

B. Surge protective devices:

1. Furnish surge protection devices across the coil of each starter, contactor, and relay.

C. Pilot devices:

1. Provide pilot lights, switches, elapsed time meters, and other devices as specified or as indicated on the Drawings.

2. As specified in Section 17710.

D. Intelligent input/output module:

1. Where required, provide networked input/output modules. Networked modules can be MCC manufacturer standard network protocol but final connection to PLC Panel shall be Modbus TCP.

E. Nameplates:

1. Provide nameplates as specified in Section 16075.

F. Motor management:

1. As indicated on the Drawings.

G. Conformal coating:

1. Provide conformal coating material applied to electronic circuitry and printed circuit boards to act as protection against moisture, dust, temperature extremes, and chemicals such as chlorine.

2.05 SOURCE QUALITY CONTROL

A. RVSS starters:

1. The manufacturer of the respective RVSS starter shall supply certified test results to confirm that the controller has been tested to substantiate designs according to applicable ANSI and NEMA standards.

2. The tests shall verify not only the performance of the unit and integrated assembly, but also the suitability of the enclosure venting, rigidity, and bus bracing. In addition, the unit shall be factory tested in accordance with ANSI standards.

3. The RVSS starter manufacturer shall test for noise immunity on both input and output power connections and provide test results to the ENGINEER. Noise testing shall be performed in accordance with NEMA ICS 2-230.40.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Starters in motor control centers:

1. Install as specified in Section 16444.

C. Starters in control panels and Vendor Control Panels:

1. Install as specified in Section 17710.

D. Individually enclosed starters:

1. Install the equipment per the manufacturer's guidelines and submitted installed instruction to meet the seismic requirements at the Project Site.

a. Perform all Work in accordance with the manufacturer's instructions and accepted shop drawings.

2. Furnish all cables, conduit, lugs, bolts, expansion anchors, sealants, mounting structures and other accessories needed to completely install the starters.

3. Assemble and install the starters in the locations and with the layouts indicated on the Drawings.

4. Install floor-standing starters on a 3-1/2 inch raised concrete housekeeping pad:

   a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.

   b. Weld and/or bolt the starter frame to the leveling channels.

5. Install wall mounted starters as specified in Section 16070.

6. Provide openings in top or bottom of the enclosure for conduit only, no additional openings will be allowed:

   a. Mis-cut holes will require that the entire enclosure or removable panel be replaced. No hole closers or patches will be allowed.

7. Bundle circuits together and terminate in each unit:

   a. Tie with nylon wire ties as specified in Section 16123.

   b. Label all wires at each end with wire numbers shown on the approved control drawings.

   c. Make all connections to and from the motor starter via terminal blocks.

8. Furnish all mounting brackets, stands, etc. that may be required to physically mount the motor starter.

E. Manual motor starters:

1. Provide complete mounting brackets and hardware as necessary for complete support of manual motor starter at locations indicated on the Drawings.

2. Mount manual motor starter rigidly to exposed building or equipment structural members.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050 and Section 01750.

3.03 ADJUSTING

A. Make all adjustments as necessary and recommended by the manufacturer, ENGINEER, or testing firm.

B. Set all overloads and motor circuit protectors based on the nameplate values of the installed motor prior to start of General Start-Up and Testing Procedures.

3.04 CLEANING

A. As specified in Section 16050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 16050 and Section 01750.

B. Demonstrate operation of equipment as specified in Section 01750:

1. Demonstrate the operation of every motor starter to the ENGINEER'S and OWNER'S satisfaction.

C. Provide the field services of a factory technician as necessary to supervise/inspect installation, test, and start-up all equipment provided under this specification:

1. Provide all equipment required for testing, start-up, and performance verification.

D. The manufacturer shall instruct the OWNER’s operations and maintenance staff on the operation and maintenance of the starter.

E. Separate classes shall be held for operations staff and maintenance staff:

1. Operations staff training shall consist of 2 identical training sessions each consisting of 1 session per day for 1 day, with each session lasting 2 hours, for a total in class time of 4 hours:

a. The 2 sessions shall be scheduled with the OWNER so that all operators have the opportunity to attend the training session.

2. Maintenance staff training shall consist of 2 identical training sessions each consisting of 1 session per day for 1 day, with each session lasting 2 hours, for a total in class time of 4 hours:

a. The 2 sessions shall be scheduled with the OWNER so that all maintenance staff has the opportunity to attend the training session.

3. Refer to Section 01750 for further requirements.

F. Provide instruction at the OWNER’s facility and utilize the actual starters installed at the site.

3.06 PROTECTION

A. As specified in Section 16050.

END OF SECTION

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SECTION 16440

METERING SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Free standing, front access only, dead-front type metal-enclosed distribution, low voltage metering switchboards, with circuit breaker circuit protective devices and generator receptacles.

2. Provide labor, equipment, supervision and materials for the installation, testing and start-up of Switchboards as shown on the Drawings and as specified herein.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

c. Section 16075 - Electrical Identification.

d. Section 16210 – Utility Coordination.

e. Section 16285 - Surge Protective Devices.

f. Section 16290 - Electrical Power Monitoring.

g. Section 16305 - Electrical System Studies.

h. Section 16412 - Low Voltage Molded Case Circuit Breakers.

1.02 REFERENCES

A. As specified in Section 16050.

B. Institute of Electrical and Electronic Engineers (IEEE).

C. National Electrical Manufacturers' Association (NEMA):

1. PB-2 - Dead-front Distribution Switchboards.

D. Underwriters' Laboratories, Inc. (UL):

1. 50 - Standard for Enclosures for Electrical Equipment.
2. 891 - Switchboards.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Factory assembled, wired, and tested switchboards, with major components being products of a single manufacturer, including but not limited to, circuit breakers, bus and enclosure with accessories and features specified in this Section and indicated on the Drawings.

B. Provide Kirk key interlocking for breakers where shown on Drawings.

C. Description of sections:

1. Customer metering section.
2. Main circuit breaker
3. Generator circuit breaker
4. Generator receptacle connection.

D. Provide nameplates as required in Section 16075.

E. Provide all equipment and materials not provided by the power Utility Company for permanent service at the locations shown on the Contract Drawings

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Manufacturer of switchboard.
2. Manufacturer of all component parts of switchboard.
3. Weight of switchboard.
4. Dimensions:
   a. Height.
   b. Length.
   c. Width.
5. Nameplate schedule.
6. Bill of material.
7. Ratings:
   a. Voltage.
   b. Phase.
   c. Current.

d. Interrupting rating (circuit breakers and fuses).

e. Momentary current rating.

8. List of recommended spare parts.

9. Name and telephone number of manufacturer's authorized parts and repair provider.

10. Furnish circuit breaker submittals as specified in:

a. Section 16412.

b. Provide ground fault for all main breakers 1000 amps and larger and where shown on Contract Drawings.

c. Provide arc flash reduction maintenance switch where shown on Contract Drawings.

C. Shop drawings:

1. Layout drawings:

a. Complete, detailed, and scaled switchboard layout:

1) Front panel.

2) Sub-panels.

3) Interior panels.

4) Top and bottom conduit windows.

D. Installation instructions:

1. The written instructions must detail the complete installation of the switchboard including rigging, moving, and setting into place.

2. Provide anchorage instructions and requirements for the switchboard based on the seismic requirements at the project site as indicated in Section 16050:

a. Stamped by a professional structural engineer registered in California.

E. Operating and maintenance manuals:

1. Submit operating instructions and a maintenance manual for the switchboard(s) furnished and/or installed under this Contract.

2. Maintenance manual:

a. Furnish maintenance manuals with instructions covering all details pertaining to care and maintenance of all equipment as well as data identifying all parts.

b. Manuals to include but are not limited to the following:

1) Adjustment and test instructions covering the steps involved in the initial test, adjustment, and start-up procedures.

F. Test reports:

1. Manufacturer to furnish a certified report after the shop tests.

2. Manufacturer to furnish a certified report after the startup:

   a. Report must state that the installation is complete and satisfactory, or list items requiring additional and a proposal for the corrective actions.

G. Certification letters:

1. Provide a letter from the switchboard manufacturer that lists every paragraph, subparagraph etc. of this Section and states compliance or non-compliance with said paragraph. If non-compliance is indicated, provide an explanation for the deviation and alternative method to address the non-compliance.

2. Provide a letter from SMUD verifying approval of all components of the proposed metering switchboard.

H. Calculations:

1. Detailed calculations or details of the actual physical testing performed on the switchboard to prove the switchboard is suitable for the seismic requirements at the Project Site.

I. Utility Coordination:

1. Prior to initial equipment shop drawing submittal to the Owner, submit to the Utility company all proposed switchboard drawings and catalog cuts including meter section, meter socket, protective relays, and service entrance switchboard details.

2. It is the responsibility of the Contractor to make all equipment approval arrangements and scheduling with the power Utility company connected with this project. Schedule within 30 days after award of contract all service installations and connections with the power Utility. Lack of effort by the Contractor to properly schedule Utility service will not be considered valid justification for delays in project completion and no extension in contract time will be given

3. Contractor shall be responsible for obtaining Utility Engineered drawings for service conductor conduits, pole risers, pull boxes, vaults, wire size requirements, pull rope requirements, etc. Conflicts between the Contract drawings and the Utility Engineered drawings shall be brought to the attention of the Engineer. Contractor shall meet all Utility requirements at no additional cost to the Owner.

4. The Contractor shall field verify the locations for the underground utility service conduit runs and pull boxes with Utility representative prior to installation.

5. The Contractor shall be responsible for providing all utility service connection conduits, pullboxes, trenching and backfill work from utility service connection point to metering switchboard MSB. Service conductors from the utility service connection point to the transformer shall be provided by the Utility Company.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Sections and devices shall be UL listed and labeled.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested by the ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.07 DELIVERY STORAGE AND HANDLING

A. As specified in Section 16050.

B. Ship the switchboard to the job site on a dedicated air ride vehicle that will allow the CONTRACTOR to utilize onsite off-loading equipment:

1. Furnish temporary equipment heaters within the switchboard to prevent condensation from forming.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 16305 and submit results for ENGINEER'S review.

B. After successful review of the initial fault current study, submit complete equipment submittal as specified in the Submittals article of this Section for ENGINEER'S review.

C. Conduct internal factory test to ensure that systems and equipment are functional and submit certified test results for ENGINEER'S review.

D. Ship equipment to Project Site after successful completion of factory acceptance test.

E. Assemble equipment in the field.

F. Conduct field acceptance test and submit results for ENGINEER'S review.

G. Submit manufacturer's certification that equipment has been properly installed and is fully functional for ENGINEER'S review.

H. Formally energize, start-up and commission equipment:

1. Startup and commissioning shall be performed by the manufacturer's authorized representative.

1.10 SCHEDULING

A. As specified in Section 16050 and Section 01750.

1.11 WARRANTY

A. As specified in Section 16050.

1.12 SYSTEM STARTUP

A. As specified in Section 16050 and Section 01750.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. General Electric Company, Spectra Series.
2. Schneider Electric/Square D, Power-Style QED.
3. Eaton/Cutler-Hammer, Pow-R-Line C.

B. Circuit breakers: Same manufacturer as the switchboard.

2.02 EQUIPMENT

A. Switchboard:

1. Furnish low voltage front access metering switchboards as specified and indicated on the Drawings.
2. Provide complete and functional switchboards with required controls.
3. Furnish and install devices or accessories not described in this Section but necessary for the proper installation and operation of the equipment.

B. Voltage ratings:

1. Voltage level and configuration: As indicated on the Drawings.
2. Frequency: 60 hertz.
3. Solidly grounded system insulation level:
   a. Twice the rated voltage plus 1,000 volts.

C. Bus:

1. General:
   a. Tin-plated copper.
   b. Bus cross-section per UL heat rise requirements.
   c. Current density of 1,000 amperes per square inch.
   d. Mounted on supports of high-impact, non-tracking insulators.
   e. Phase A-B-C bus arrangement:
      1) Top-to-bottom, left-to-right, front-to-back throughout the switchboard.

f. Symmetrical short circuit current bracing of as indicated on the Drawings.

g. Continuous current rating as indicated on the Drawings.

2. Horizontal bus:

a. Provisions for future connections to additional switchboard sections.

3. Ground bus:

a. Sized per UL 891.

D. Utility Metering:

1. Furnish a separate barriered-off Utility metering section complete with hinged sealable door.

2. Meter section shall include provisions for mounting Utility company meter, test blocks and other devices as required by the Utility Company.

3. Provide Service Entrance UL Label and provide necessary applicable service entrance features per power Utility company requirements.

E. Enclosure:

1. General:

a. Self-supporting structures bolted together to form the required line-up.

b. All sections rear aligned.

c. Dead-front.

d. Conduit entry:

1) Open-bottom.

2) Removable top cover.

2. Frame:

a. Die-formed 12 gauge steel.

3. Covers:

a. Bolt-on.

b. Code gauge steel.

c. Removable front covers.

1) Held in place by captive screws.

4. Rating:

a. NEMA Type 1.

2.03 COMPONENTS

A. Circuit breakers:

1. General:

a. Molded case circuit breakers as specified in Section 16412.

2. Main and tie circuit breaker:

a. Frame, trip and short circuit ratings as indicated on the Drawings.

b. Molded case.

3. Feeder breakers:

a. Frame, trip and short circuit ratings as indicated on the Drawings.

B. Wiring:

1. Provide all necessary internal wiring, fuse blocks, and terminal blocks as required.

2. Number all wires at each end and indicate wire numbers on shop drawings.

3. Type SIS switchboard wire with at least 26 strands.

4. Minimum wire size:

a. No. 14 for control circuits.

b. No. 12 for potential and current transformer circuits.

5. Numbered and labeled in accordance with Section 16075.

C. Generator Connectors:

1. For services over 100 A and 480 V provide Crouse-Hinds E1016 Series, 600 V, 400 A, female, double set-screw, cable connectors as shown on the Plans. The connector color shall be provided per Plans:

2.04 ACCESSORIES

A. Nameplates:

1. Provide engraved plastic nameplates to identify:

a. Switchboard units.

b. Door mounted components.

c. Interior mounted devices.

d. Provide network address for networked devices, complete with Modbus RTU addresses.

2. As specified in Section 16075.

3. Engraved with the circuit number and circuit name as indicated on the Drawings.

4. Manufacturers labels:

a. Each vertical section shall have a label identifying:

1) Serial number.

2) Shop order number.

3) Bus rating.

4) Vertical section reference number.

5) Date of manufacture.

B. Warning signs:

1. Voltage:

a. Provide a minimum of 2 warning signs on the front of the switchboard lineup.

b. Red laminated plastic engraved with white letters approximately 1/2 inch high.

c. Signs shall read:

1) "WARNING-HIGH VOLTAGE-KEEP OUT."

2. Arc flash:

a. Provide one warning sign for each switchboard compartment.

b. Signs shall have read a minimum of:

1) "DANGER ELECTRIC ARC FLASH HAZARD."

2) Signs shall meet the requirements of NFPA 70E and NEC Article 110.16.

C. Lugs:

1. For all external connections of No. 6 AWG or larger.

2. UL listed for copper or aluminum conductors.

3. Rated for 75-degree Celsius conductors.

D. Switchboard Rubber Matting:

1. Furnish and install high voltage switchboard rubber matting in front of equipment. Matting shall be black, ¼" thick, 48" wide and running full length of equipment plus 12" on both sides.

2. Matting shall conform to ASTM D178-93 Type 1 Class 2, proof tested at 20,000 volts AC.

3. Manufacturers or equal:

a. Warco Biltrite ASTM Switchboard Type 1 Rubber Matting.

2.05 FINISHES

A. Chemically clean all steel surfaces before painting.

B. Exterior color ANSI 61 over phosphate-type rust inhibitor.

2.06 SOURCE QUALITY CONTROL

A. Completely assemble, wire and test switchboard at the factory:

1. Provide groups of wires leaving the shipping-assembled equipment with terminal blocks with suitable numbering strips.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Install the switchboard per the manufacturer's guidelines and submitted installation instructions to meet the seismic requirements at the Project Site.

C. General:

1. Furnish all cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories needed to complete the installation of the switchboard.

2. Assemble and install the switchboard in the location and layout indicated on the Drawings.

3. Perform work in accordance with manufacturer's instructions and shop drawings.

4. Furnish components and equipment as required to complete the installation.

5. Replace any hardware lost or damaged during the installation or handling to provide a complete installation.

6. Install the switchboard on a 3-1/2-inch raised concrete housekeeping pad:

a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.

b. Weld and/or bolt the switchboard frame to be to the leveling channels.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050 and Section 01750.

B. Provide Field Acceptance Testing per Section 16950.

3.03 ADJUSTING

A. Make all adjustments as necessary and recommended by the manufacturer, ENGINEER or testing firm.

3.04 CLEANING

A. As specified in Section 16050.

B. Install switchboard rubber matting after cleaning of electrical room.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 16050 and Section 01750.

B. Demonstrate the operation to the ENGINEER's and OWNER's satisfaction.

C. Training:

1. Provide instruction of the OWNER’s operation and maintenance staff on the operation and maintenance of the metering low voltage switchboards.

2. Separate classes are required for the operations staff and maintenance staff:

a. Operations staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Operations training time is 4 hours (2 classes of 2 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all operators have the opportunity to attend.

b. Maintenance staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Maintenance training time is 4 hours (2 classes of 2 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all maintenance staff has the opportunity to attend.

c. Instruction shall occur at the OWNER’s facility and shall utilize the actual low voltage switchboards installed at the site.

D. Refer to Section 01750 for further training requirements.

E. Preventive maintenance procedures shall also be demonstrated for Owner personnel during this training period.

3.06 PROTECTION

A. As specified in Section 16050.

END OF SECTION

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SECTION 16441

GROUP-MOUNTED CIRCUIT BREAKER SWITCHBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Free standing, front access only, dead-front type metal-enclosed distribution, low voltage switchboards, utilizing group mounted circuit protective devices.

2. Provide labor, equipment, supervision and materials for the installation, testing and start-up of Switchboards as shown on the Drawings and as specified herein.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

c. Section 16075 - Electrical Identification.

d. Section 16285 - Surge Protective Devices.

e. Section 16290 - Electrical Power Monitoring.

f. Section 16305 - Electrical System Studies.

g. Section 16412 - Low Voltage Molded Case Circuit Breakers.

1.02 REFERENCES

A. As specified in Section 16050.

B. Institute of Electrical and Electronic Engineers (IEEE).

C. National Electrical Manufacturers' Association (NEMA):

1. PB-2 - Dead-front Distribution Switchboards.

D. Underwriters' Laboratories, Inc. (UL):

1. 50 - Standard for Enclosures for Electrical Equipment.

2. 891 - Switchboards.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Factory assembled, wired, and tested switchboards, with major components being products of a single manufacturer, including but not limited to, circuit breakers, bus and enclosure with accessories and features specified in this Section and indicated on the Drawings.

B. Provide Kirk key interlocking for breakers where shown on Drawings.

C. Description of sections:

1. Customer metering section shall include power quality monitoring equipment and surge protection device.

2. Space for future devices:

a. Where indicated on the Drawings, space for future devices shall include:

1) All necessary bus.

2) Device supports.

3) Device mounting equipment.

4) Device connections to bus work.

5) Wire troughs or raceway space.

6) Unused device space shall be covered with blank code gauge steel covers or doors.

D. Provide nameplates as required in Section 16075.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Manufacturer of switchboard.

2. Manufacturer of all component parts of switchboard.

3. Weight of switchboard.

4. Dimensions:

a. Height.

b. Length.

c. Width.

5. Nameplate schedule.

6. Bill of material.

7. Ratings:

a. Voltage.

b. Phase.

c. Current.

d. Interrupting rating (circuit breakers and fuses).

e. Momentary current rating.

8. List of recommended spare parts.

9. Name and telephone number of manufacturer's authorized parts and repair provider.

10. Furnish circuit breaker submittals as specified in:

a. Section 16412.

b. Provide ground fault for all main breakers 1000 amps and larger and where shown on Contract Drawings.

c. Provide arc flash reduction maintenance switch where shown on Contract Drawings.

C. Shop drawings:

1. Layout drawings:

a. Complete, detailed, and scaled switchboard layout:

1) Front panel.

2) Sub-panels.

3) Interior panels.

4) Top and bottom conduit windows.

D. Installation instructions:

1. The written instructions must detail the complete installation of the switchboard including rigging, moving, and setting into place.

2. Provide anchorage instructions and requirements for the switchboard based on the seismic requirements at the project site as indicated in Section 16050:

a. Stamped by a professional structural engineer registered in California.

E. Operating and maintenance manuals:

1. Submit operating instructions and a maintenance manual for the switchboard(s) furnished and/or installed under this Contract.

2. Maintenance manual:

a. Furnish maintenance manuals with instructions covering all details pertaining to care and maintenance of all equipment as well as data identifying all parts.

b. Manuals to include but are not limited to the following:

1) Adjustment and test instructions covering the steps involved in the initial test, adjustment, and start-up procedures.

F. Test reports:

1. Manufacturer to furnish a certified report after the shop tests.

2. Manufacturer to furnish a certified report after the startup:

a. Report must state that the installation is complete and satisfactory, or list items requiring additional and a proposal for the corrective actions.

G. Certification letters:

1. Provide a letter from the switchboard manufacturer that lists every paragraph, subparagraph etc. of this Section and states compliance or non-compliance with said paragraph. If non-compliance is indicated, provide an explanation for the deviation and alternative method to address the non-compliance.

H. Calculations:

1. Detailed calculations or details of the actual physical testing performed on the switchboard to prove the switchboard is suitable for the seismic requirements at the Project Site.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Sections and devices shall be UL listed and labeled.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested by the ENGINEER, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.07 DELIVERY STORAGE AND HANDLING

A. As specified in Section 16050.

B. Ship the switchboard to the job site on a dedicated air ride vehicle that will allow the CONTRACTOR to utilize onsite off-loading equipment:

1. Furnish temporary equipment heaters within the switchboard to prevent condensation from forming.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 16305 and submit results for ENGINEER'S review.

B. After successful review of the initial fault current study, submit complete equipment submittal as specified in the Submittals article of this Section for ENGINEER'S review.

C. Conduct internal factory test to ensure that systems and equipment are functional and submit certified test results for ENGINEER'S review.

D. Ship equipment to Project Site after successful completion of factory acceptance test.

E. Assemble equipment in the field.

F. Conduct field acceptance test and submit results for ENGINEER'S review.

G. Submit manufacturer's certification that equipment has been properly installed and is fully functional for ENGINEER'S review.

H. Formally energize, start-up and commission equipment:

1. Startup and commissioning shall be performed by the manufacturer's authorized representative.

1.10 SCHEDULING

A. As specified in Section 16050 and Section 01750.

1.11 WARRANTY

A. As specified in Section 16050.

1.12 SYSTEM STARTUP

A. As specified in Section 16050 and Section 01750.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. General Electric Company, Spectra Series.

2. Schneider Electric/Square D, Power-Style QED.

3. Eaton/Cutler-Hammer, Pow-R-Line C.

B. Circuit breakers: Same manufacturer as the switchboard.

2.02 EQUIPMENT

A. Switchboard:

1. Furnish low voltage front access grouped mounted circuit breaker switchboards as specified and indicated on the Drawings.

2. Provide complete and functional switchboards with required controls.

3. Furnish and install devices or accessories not described in this Section but necessary for the proper installation and operation of the equipment.

B. Voltage ratings:

1. Voltage level and configuration: As indicated on the Drawings.

2. Frequency: 60 hertz.

3. Solidly grounded system insulation level:

a. Twice the rated voltage plus 1,000 volts.

C. Bus:

1. General:

a. Tin-plated copper.

b. Bus cross-section per UL heat rise requirements.

c. Current density of 1,000 amperes per square inch.

d. Mounted on supports of high-impact, non-tracking insulators.

e. Phase A-B-C bus arrangement:

1) Top-to-bottom, left-to-right, front-to-back throughout the switchboard.

f. Symmetrical short circuit current bracing of as indicated on the Drawings.

g. Continuous current rating as indicated on the Drawings.

2. Horizontal bus:

a. Provisions for future connections to additional switchboard sections.

3. Ground bus:

a. Sized per UL 891.

D. Enclosure:

1. General:

a. Self-supporting structures bolted together to form the required line-up.

b. All sections rear aligned.

c. Dead-front.

d. Conduit entry:

1) Open-bottom.

2) Removable top cover.

2. Frame:

a. Die-formed 12 gauge steel.

3. Covers:

a. Bolt-on.

b. Code gauge steel.

c. Removable front covers.

1) Held in place by captive screws.

4. Rating:

a. NEMA Type 1.

2.03 COMPONENTS

A. Circuit breakers:

1. General:

a. Molded case circuit breakers as specified in Section 16412.

2. Main and tie circuit breaker:

a. Frame, trip and short circuit ratings as indicated on the Drawings.

b. Molded case.

3. Feeder breakers:

a. Frame, trip and short circuit ratings as indicated on the Drawings.

B. Wiring:

1. Provide all necessary internal wiring, fuse blocks, and terminal blocks as required.

2. Number all wires at each end and indicate wire numbers on shop drawings.

3. Type SIS switchboard wire with at least 26 strands.

4. Minimum wire size:

a. No. 14 for control circuits.

b. No. 12 for potential and current transformer circuits.

5. Numbered and labeled in accordance with Section 16075.

2.04 ACCESSORIES

A. Metering system:

1. Provide Power Monitoring meters as indicated on the Drawings and as specified in Section 16290.

2. Final connection from Power Monitoring meter's Modbus 485 communication network terminals to local PLC Panel shall accept RS-485 cable which is rated for installation within Switchboard wireway.

B. Surge protective devices:

1. Provide Surge Protective devices as indicated on the Drawings and as specified in Section 16285.

2. Provide wiring from Surge Protective device to local PLC Panel for alarm status.

C. Nameplates:

1. Provide engraved plastic nameplates to identify:

a. Switchboard units.

b. Door mounted components.

c. Interior mounted devices.

d. Provide network address for networked devices, complete with Modbus RTU addresses.

2. As specified in Section 16075.

3. Engraved with the circuit number and circuit name as indicated on the Drawings.

4. Manufacturers labels:

a. Each vertical section shall have a label identifying:

1) Serial number.

2) Shop order number.

3) Bus rating.

4) Vertical section reference number.

5) Date of manufacture.

D. Warning signs:

1. Voltage:

a. Provide a minimum of 2 warning signs on the front of the switchboard lineup.

b. Red laminated plastic engraved with white letters approximately 1/2 inch high.

c. Signs shall read:

1) "WARNING-HIGH VOLTAGE-KEEP OUT."

2. Arc flash:

a. Provide one warning sign for each switchboard compartment.

b. Signs shall have read a minimum of:

1) "DANGER ELECTRIC ARC FLASH HAZARD."

2) Signs shall meet the requirements of NFPA 70E and NEC Article 110.16.

E. Lugs:

1. For all external connections of No. 6 AWG or larger.

2. UL listed for copper or aluminum conductors.

3. Rated for 75-degree Celsius conductors.

F. Switchboard Rubber Matting:

1. Furnish and install high voltage switchboard rubber matting in front of equipment. Matting shall be black, ¼" thick, 48" wide and running full length of equipment plus 12" on both sides.

2. Matting shall conform to ASTM D178-93 Type 1 Class 2, proof tested at 20,000 volts AC.

3. Manufacturers or equal:

a. Warco Biltrite ASTM Switchboard Type 1 Rubber Matting.

2.05 FINISHES

A. Chemically clean all steel surfaces before painting.

B. Exterior color ANSI 61 over phosphate-type rust inhibitor.

2.06 SOURCE QUALITY CONTROL

A. Completely assemble, wire and test switchboard at the factory:

1. Provide groups of wires leaving the shipping-assembled equipment with terminal blocks with suitable numbering strips.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Install the switchboard per the manufacturer's guidelines and submitted installation instructions to meet the seismic requirements at the Project Site.

C. General:

1. Furnish all cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories needed to complete the installation of the switchboard.

2. Assemble and install the switchboard in the location and layout indicated on the Drawings.

3. Perform work in accordance with manufacturer's instructions and shop drawings.

4. Furnish components and equipment as required to complete the installation.

5. Replace any hardware lost or damaged during the installation or handling to provide a complete installation.

6. Install the switchboard on a 3-1/2-inch raised concrete housekeeping pad:

a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.

b. Weld and/or bolt the switchboard frame to be to the leveling channels.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050 and Section 01750.

B. Configure Power Monitoring metering and Surge Protective device prior to General Start-Up and Testing Procedures.

C. Provide Field Acceptance Testing per Section 16950.

3.03 ADJUSTING

A. Make all adjustments as necessary and recommended by the manufacturer, ENGINEER or testing firm.

3.04 CLEANING

A. As specified in Section 16050.

B. Install switchboard rubber matting after cleaning of electrical room.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 16050 and Section 01750.

B. Demonstrate the operation to the ENGINEER's and OWNER's satisfaction.

C. Training:

1. Provide instruction of the OWNER’s operation and maintenance staff on the operation and maintenance of the low voltage switchboards.

2. Separate classes are required for the operations staff and maintenance staff:

a. Operations staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Operations training time is 4 hours (2 classes of 2 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all operators have the opportunity to attend.

b. Maintenance staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Maintenance training time is 4 hours (2 classes of 2 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all maintenance staff has the opportunity to attend.

c. Instruction shall occur at the OWNER’s facility and shall utilize the actual low voltage switchboards installed at the site.

D. Refer to Section 01750 for further training requirements.

3.06 PROTECTION

A. As specified in Section 16050.

END OF SECTION

SECTION 16444

LOW VOLTAGE MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Provide labor, equipment, supervision, and materials for the installation, testing and start-up of intelligent motor control center (MCC) as shown on the Drawings and as specified herein.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. All Sections that include vendor supplied equipment that is powered and controlled from MCC.

c. Section 16050 - Common Work Results for Electrical.

d. Section 16075 - Electrical Identification.

e. Section 16123 - 600 Volt or Less Wires and Cables.

f. Section 16150 - Low Voltage Wire Connections.

g. Section 16272 - Dry Type Transformers.

h. Section 16285 - Surge Protective Devices.

i. Section 16290 - Electrical Power Monitoring.

j. Section 16305 - Electrical System Studies.

k. Section 16412 - Low Voltage Molded Case Circuit Breakers.

l. Section 16422 - Motor Starters.

m. Section 16494 - Low Voltage Fuses.

n. Section 16950 – Field Electrical Acceptance Test.

o. Section 17710 - Control Systems- Panels, Enclosures, and Panel Components.

1.02 REFERENCES

A. As specified in Section 16050.

B. National Electrical Manufacturer's Association (NEMA):

1. ICS 18-2001 - Motor Control Centers.

C. Underwriters Laboratories (UL):

1. 845 - Motor Control Centers.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Factory assembled, factory wired and factory tested intelligent MCC:

1. Motor control center and major components to be products of a single manufacturer including, but not limited:

a. Starters.

b. Power Monitoring with Modbus 485 communications.

c. Circuit breakers.

d. Related equipment specified in the Contract Documents or indicated on the Drawings.

2. Intelligent motor control centers shall be provided with Modbus TCP communication networks as required for a complete networked system. MCC shall communicate with the local PLC Panel via Cat 6 cables. MCC network components and equipment shall be programmed and configured by the manufacturer prior to General Start-Up and Testing Procedures as specified in Section 01750, 16050 and 16950.

a. Submit all communication configuration parameters for ENGINEER and OWNER approval and coordination with Control Network.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Manufacturer of motor control center.

2. Manufacturer of motor control center parts.

3. Nameplate schedule.

4. Bill of material.

5. Network map and assigned addresses for all components including Ethernet Modbus TCP communication adapters, and intelligent motor starters.

6. Enclosure;

a. NEMA rating.

b. Finish color.

7. Ratings:

a. Voltage.

b. Phase.

c. Current:

1) Horizontal bus ampacity.

2) Vertical bus ampacity.

3) Ground bus ampacity.

d. Short circuit withstand rating.

e. Protective device interrupting rating.

8. List of recommended spare parts.

9. Catalog cut sheets:

a. Submit complete manufacturer's catalog information:

1) Clearly indicate the features of the equipment including any options necessary to meet the required functionality.

10. Furnish circuit breaker submittals as specified in Section 16412.

C. Shop drawings:

1. Layout drawings:

a. Provide fully dimensioned and to scale layout drawings which include:

1) Dimensions:

a) Overall length.

b) Overall width.

c) Overall height.

d) Overall weight and weight of individual shipping splits.

2. Interfaces to other equipment.

3. Shipping splits.

4. Allowable top and bottom conduit windows.

5. Complete component and unit layout drawings.

6. Indicate lug sizes, type, and manufacturer based on the cable size specified in the Contract Documents and as indicated on the Drawings.

7. Elementary schematics:

a. Provide one custom schematic diagram for each compartment:

1) Include all remote devices.

2) Show wire numbers on the schematics:

a) Provide wire numbering as specified in Section 16075.

8. External connection diagram showing the wiring to the external controls and devices associated with the motor control center.

9. One-line diagrams:

a. Provide complete one-line diagrams for each motor control center, including but not limited to: protective devices, starters, drives, metering, and other equipment.

b. Indicate electrical ratings of the equipment shown on the one-line diagrams.

D. Installation instructions:

1. Detail the complete installation of the motor control center including rigging, moving, and setting into place.

2. Provide anchorage instructions and requirements for the motor control center based on the seismic requirements at the Project Site as indicated in Section 16050:

a. Stamped by a professional structural engineer registered in California.

E. Operation and maintenance manuals:

1. Provide complete operating and maintenance instructions presenting full details for care and maintenance of all types of equipment furnished and/or installed under this Section. Include the following:

a. Electrical ratings:

1) Phase.

2) Wire.

3) Voltage.

4) Ampacity.

5) Bus bracing and protective device interrupting ratings.

b. Manufacturer's operating and maintenance instructions for the motor control center and all component parts, including:

1) Starters.

2) Overload relays and heater elements.

3) Variable frequency drives.

4) Protective devices including, but not limited to, fuses, circuit breakers and protective relays.

5) Pilot devices.

c. Complete renewal parts list.

F. Record Documents shall be provided in AutoCAD and PDF formats. Drawings shall include:

1. Elementary schematics:

a. Furnish as-built elementary schematics indicating final:

1) Wire numbers.

2) Interfaces with other equipment.

b. Provide one custom schematic diagram for each compartment:

1) Include all remote devices.

2) Show wire numbers on the schematics.

c. Layout drawings: Provide complete dimensioned component and unit layout drawings.

2. The Record Documents shall reflect all modifications made during the submittal review process and during construction.

G. Calculations:

1. Detailed calculations or details of the actual physical testing performed on the motor control center to prove the motor control center is suitable for the seismic requirements at the Project Site.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. All portions of the motor control center, vertical bays, and components shall be UL listed and labeled.

1.07 DELIVERY, STORAGE AND HANDLING

A. As specified in Section 16050.

B. Ship the motor control center and associated equipment to the job site on a dedicated air ride vehicle that will allow the CONTRACTOR to utilize onsite off-loading equipment.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 16305 and submit results for ENGINEER's review.

B. After successful review of the initial fault current study, as specified in Section 16305, submit complete equipment submittal as specified in the Submittals article of this Section for ENGINEER's review.

C. Conduct internal factory test to ensure that systems and equipment are functional and submit certified test results for ENGINEER's review.

D. Ship equipment to the Project Site after configuring intelligent MCC components and equipment and successful completion of factory acceptance test.

E. Assemble equipment in the field.

F. Conduct field acceptance test and submit results for ENGINEER's review as part of General Start-Up and Testing Procedures.

G. Conduct Functional Testing per Section 01750, 16050 and 16950.

H. Conduct OWNER's Training Sessions.

I. Submit manufacturer's certification that equipment has been properly installed and is fully functional for ENGINEER's review.

J. Conduct Operational Testing per Section 01750, 16050 and 16950.

1.10 SCHEDULING

A. As specified in Section 16050.

1.11 WARRANTY

A. As specified in Section 16050.

1.12 SYSTEM STARTUP

A. As specified in Section 16050, 16950 and Section 01750.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Allen-Bradley IntelliCENTER.
2. Eaton Freedom 2100 Intelligent MCC.
3. Square D iMCC6.
4. General Electric Spectra 8000 Intelligent MCC.

2.02 EQUIPMENT

A. General:

1. Furnish motor control centers as specified in the Contract Documents and indicated on the Drawings.
2. Arrange the equipped sections side by side to form continuous motor control center lineups as indicated on the Drawings:
   a. Identify any deviations from the Drawings in writing and submit for approval.
3. Provide complete and functional motor control centers.
4. Provide devices or accessories not specified in this Section but necessary for the proper installation and operation of the equipment.

5. Provide new components of the latest construction series available from the manufacturer.

B. Design and construct motor control center to operate at the voltage level and configuration indicated on the Drawings.

C. Bus system:

1. Material:

a. Tin-plated copper.

b. Short-circuit rating:

1) As indicated on the Drawings.

c. Bus bar supports:

1) High impact strength, non-tracking glass-polyester material that is impervious to moisture and gases.

2. Horizontal power bus:

a. Current-carrying capacity as indicated on the Drawings.

b. Mounting:

1) Mount horizontal bus bars edgewise, one above the other, and fully isolated from all wireways and units.

c. Temperature rise:

1) In accordance with UL 845.

2) De-rate the temperature rating of the bus for the specified conditions of ambient temperature and altitude as specified in Section 16050.

3. Vertical power bus:

a. Current-carrying capacity of not less than 300 amps.

b. Mounting:

1) Enclose the vertical bus in a polyester-glass cover with small openings to permit unit stabs to mate with the bus:

a) Provide a shutter mechanism to cover the stab openings when plug-in units are removed.

2) Provide top and bottom bus covers for insulation and isolation of the ends of the bus.

c. Isolated from the unit compartments by a full height barrier.

4. Ground bus:

a. Horizontal ground bus:

1) Current-carrying capacity of not less than 300 amps.

2) Mounting:

a) Full-width, firmly secured to each vertical section structure:

(1) Located in the top or bottom wireway.

b) Pre-drilled and furnished with lugs for connection to equipment ground wires:

(1) Furnish a minimum of 10 lugs per vertical section of MCC.

b. Vertical ground bus.

1) Mounting:

a) Furnish in each vertical section.

b) Bolted to the horizontal ground bus.

c) Install parallel to the vertical power bus.

d) Mount vertical ground bus such that plug-in units engage the ground bus before any connection to the power bus is made. Upon removal of plug-in units, ground stabs are disconnected from the ground bus after the power stabs have been disconnected.

5. Bus splice bars:

a. Provided to join the bus at the splits.

b. Connected to each horizontal bus bar with a minimum of two bolts.

c. Employ conical or spring washers at connections, designed to maintain constant pressure against the splice joint.

d. Same ampacity rating as the horizontal bus.

D. Enclosures:

1. Each motor control center shall consist of 1 or more vertical sections bolted together:

a. Freestanding.

b. Totally enclosed.

c. Dead-front assembly.

d. Designed for modification and/or addition of future vertical sections.

e. Form each vertical section of heavy gauge steel.

2. Enclosure rating:

a. Indoor:

1) NEMA Type 1 gasketed.

3. Standard section dimensions:

a. Nominal height: 90 inches.

b. Nominal depth: 20 inches.

c. Vertical section width as indicated on the Drawings.

4. Wireways:

   a. Provide each vertical section with a horizontal wireway at the top and bottom of the section:

      1) Arranged to provide a full-width metal enclosed wiring trough across the entire motor control center assembly.

   b. Provide each vertical section with a full-height vertical wireway.

   c. Completely isolated from the vertical and horizontal bus bars.

   d. Provide a removable, hinged door.

5. Shipping splits:

   a. No more than 3 vertical sections and not more than 60 inches in width.

   b. Solid bussing between vertical sections in a shipping split is not acceptable.

6. Lifting angles:

   a. Furnish each vertical section and/or shipping split with a removable lifting angle mounted to the top of the enclosure:

      1) Extending the entire width of the shipping split.

7. Mounting channels:

   a. Mount each vertical section and/or shipping split on an external 1.5-inch by 3-inch mounting channel.

E. Units:

1. A plug-in unit consists of:

   a. Unit assembly.

   b. Unit support pan.

   c. Unit door assembly.

2. Completely enclosed and isolated from adjacent units, buses, and wireways, except for conductor entries into the unit, by a metal enclosure.

3. Constructed so that any fault will be contained in the unit compartment.

4. Supported and guided by a removable unit support pan:

   a. Re-arrangement of units and the removal of a unit so that a new and possibly larger unit can be added without the removal of an in-service unit to gain access to the unit support pan.

5. Held in place by screws or other positive locking means after insertion.

6. Provide a test position with the unit supported in the structure but disengaged from the bus.

7. Integral plug-in ground stab.

8. Stabs:

   a. Free floating.

b. Self-aligning.

c. Backed by spring steel clips to ensure high pressure contacts:

d. Electrolytically tin-plated copper.

9. Handle:

a. Provide a flange mounted handle mechanism to operate each disconnect switch or circuit breaker.

b. Door mounted operators or operator handles are not acceptable.

c. Engaged with the disconnect device at all times as an integral part of the unit independent of the door position.

d. Lockable in the “OFF” position with up to 3 padlocks.

e. Mechanically interlocked so that the door cannot be opened with the handle in the “ON” position.

1) Provide a means for qualified personnel to defeat this interlock.

f. Interlocked so the unit cannot be inserted or withdrawn with the handle in the “ON” position.

g. Lockable in the “ON” position:

1) This shall not prevent the circuit breaker from operating and opening the contacts in the event of a fault condition.

h. Color-coded to indicate position.

i. Located so the center of the grip when it is in its highest position is not more than 6 feet 7 inches above the finished floor, including the height of the housekeeping pad and mounting channels.

10. Where indicated on the Drawings, provide units for spaces and future equipment:

a. Equip these units to accept a future plug-in unit without modification to the vertical sections.

F. Communication equipment:

1. Furnish motor control centers (MCCs) with a factory installed Modbus TCP communications network for connection to PLC control network.

2. The MCC intelligent network shall include a complete and tested cabling system. MCCs may incorporate sub-network with a gateway to the Modbus TCP network.

3. MCC network:

a. MCC network shall be completely configured with addressing noted on submittals.

4. Accessories:

a. Provide the MCC with a power supply to provide power to communication devices.

2.03 COMPONENTS

A. Provide components contained within the motor control center as specified in:

1. Section 16075.
2. Section 16123.
3. Section 16150.
4. Section 16272.
5. Section 16285.
6. Section 16290.
7. Section 16412.
8. Section 16422.
9. Section 16494.

2.04 ACCESSORIES

A. Wiring:

1. Wire the motor control center in accordance with the following NEMA Class and Type as defined by NEMA ICS 18-2001:

a. NEMA Class II-S:

1) Furnish wiring diagrams for individual units consisting of drawings that identify electrical devices, electrical connections, and indicate terminal numbering designations.

2) Furnish individual unit diagrams with each unit and include inter-wiring between units, i.e. electrical interlocking, etc., as specifically specified in the Contract Documents.

3) Provide custom drawings with unique terminal numbering designations in lieu of standard manufacturer drawings.

b. NEMA Type B wiring:

1) Control wiring:

a) Type B-T pull-apart terminal blocks.

2) Power wiring:

a) Type B-T for Size 1 starters.

b) Type B-T or B-D for Size 2 and 3 starters.

c) Type B for Size 4 and larger starters and feeder units.

B. Lugs and terminals:

1. For all external connections of No. 6 AWG wire or larger:

a. UL listed for copper or aluminum conductors.

2. Compression type, requiring a hydraulic press and die for installation.

C. Intelligent networked components:

1. Intelligent networked components shall be MCC manufacturer standard projects. Final connection from MCC intelligent network to local PLC Panel shall accept Cat 6 cables, rated for installation within MCC wireway, with Modbus TCP protocol.

2. No more than one vertical section of MCC starters per intelligent network to local PLC Panel. Provide for multiple Modbus TCP connections.

D. Metering system:

1. Provide Power Monitoring meters as indicated on the Drawings and as specified in Section 16290.

2. Final connection from Power Monitoring meter's Modbus 485 communication network terminals to local PLC Panel shall accept RS-485 cable.

E. Surge protective devices:

1. Provide Surge Protective devices as indicated on the Drawings and as specified in Section 16285.

2. Provide wiring from Surge Protective device to local PLC Panel for alarm status.

F. Nameplates:

1. Provide nameplates as specified in Section 16075:

   a. Identifying the motor control center designation as indicated on the Drawings.

2. Identifying each vertical section:

   a. Mounted and centered on the top horizontal wireway of the vertical section.

3. Furnish individual nameplates for each unit indicated on the Drawings:

   a. 1 nameplate to identify the unit designation complete with network address and/or node number.

   b. 1 nameplate to identify the load served.

   c. Furnish space units with blank nameplates.

4. Manufacturer's labels:

   a. Furnish each vertical section with a label identifying:

      1) Serial number.

      2) Bus rating.

      3) Vertical section reference number.

      4) Date of manufacture.

      5) Catalog number of section.

G. Warning signs:

1. Voltage:

a. Provide a minimum of 2 warning signs on the front of the MCC lineup.

b. Red laminated plastic engraved with white letters approximately 1/2 inch high.

c. Signs shall read:

1) "WARNING-HIGH VOLTAGE-KEEP OUT."

2. Arc flash:

a. Provide one warning sign for each MCC compartment.

b. Signs shall have read a minimum of:

1) "DANGER ELECTRIC ARC FLASH HAZARD."

2) Signs shall meet the requirements of NFPA 70E and NEC Article 110.16.

H. Switchboard Rubber Matting:

1. Furnish and install high voltage switchboard rubber matting in front of equipment. Matting shall be black, ¼" thick, 48" wide and running full length of equipment plus 12" on both sides.

2. Matting shall conform to ASTM D178-93 Type 1 Class 2, proof tested at 20,000 volts AC.

3. Manufacturers or equal:

a. Warco Biltrite ASTM Switchboard Type 1 Rubber Matting.

2.05 FINISHES

A. Finish metal surfaces and structural parts with phosphatizing, or equal, treatment before painting.

B. Finish interior surfaces including bus support angles, control unit back plates, and top and bottom barrier plates with baked white enamel.

C. Finish exterior of enclosure with ANSI 61 gray.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. As specified in Section 16050.

B. Install the motor control center per the manufacturer's guidelines and submitted installation instructions to meet the seismic requirements at the Project Site.

C. General:

1. Furnish all cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories necessary to completely install the motor control center for the line, load, and control connections.

2. Assemble and install the motor control center in the locations and with the layouts as indicated on the Drawings.

3. Make bus splice connections.

4. Perform work in accordance with manufacturer's instruction and shop drawings.

5. Furnish all components, and equipment necessary to complete the installation.

6. Replace hardware, lost or damaged during installation or handling, in order to provide a complete installation.

7. Install the MCC on a 3-1/2-inch raised concrete housekeeping pad:

a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.

1) Remove the manufacturer's supplied mounting channels as required by the manufacturer's installation instructions.

b. Weld and/or bolt the motor control center frame to leveling channels.

D. Provide openings in the top or bottom of the motor control center for conduit only.

1. No additional openings will be accepted:

a. Mis-cut holes will require that the entire vertical section or removable panel be replaced.

b. No hole closers or patches will be accepted.

E. Bundle circuits together and terminate in each unit:

1. Tie with nylon wire ties as specified in Section 16123.

2. Label all wires at each end with wire numbers as shown on the approved elementary schematics.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050 and Section 01750.

B. Provide the services of a manufacturer's representative to:

1. Inspect, verify, and certify that the motor control center installation meets the manufacturer's requirements.

C. Configure intelligent starters, Power Monitoring metering and Surge Protective device.

D. Provide Field Acceptance Testing per Section 16950.

3.03 ADJUSTING

A. Make all adjustments as necessary and recommended by the manufacturer, ENGINEER, or testing firm.

3.04 CLEANING

A. As specified in Section 16050.

B. Install Motor Control Center rubber matting after cleaning of Electrical Room.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 16050 and Section 01750.

B. Provide the field services of a factory technician as necessary to supervise/inspect installation, test, and start-up all equipment provided under this specification:

1. Provide all equipment required for testing, start-up and performance verification.

2. Coordinate with OWNER's PLC Programmer to validate communication with each networked device within intelligent MCC. Coordination to be conducted after successful initial testing (to validate internal MCC communication), yet prior to MCC General Start-Up and Testing Procedures.

C. The manufacturer shall instruct the OWNER's operations and maintenance staff on the operation and maintenance of the MCCs.

1. Provide training on MCC networking including communication modules, addressing troubleshooting, adding equipment in the future, etc.

2. Preventive maintenance procedures shall also be demonstrated for Owner personnel during this training period.

D. Separate classes shall be held for operations staff and maintenance staff:

1. Operations staff training shall consist of 2 identical training sessions each consisting of 1 session per day for 1 day, with each session lasting 2 hours, for a total in class time of 4 hours:

a. The 2 sessions shall be scheduled with the OWNER so that all operators have the opportunity to attend the training session.

2. Maintenance staff training shall consist of 2 identical training sessions each consisting of 1 session per day for 1 day, with each session lasting 2 hours, for a total in class time of 4 hours:

a. The 2 sessions shall be scheduled with the OWNER so that all maintenance staff has the opportunity to attend the training session.

3. Coordinate with Section 16422.

4. Refer to Section 01750 for further training requirements.

E. Provide instruction at the OWNER's facility and utilize the actual MCCs installed at the site.

3.06 PROTECTION

A. As specified in Section 16050.

END OF SECTION

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SECTION 16445

PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Panelboards serving facility feeder circuits, branch circuits or other utilization equipment at the voltage levels and configurations indicated on the Drawings.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

c. Section 16075 - Electrical Identification.

d. Section 16285 - Surge Protective Devices.

e. Section 16412 - Low Voltage Molded Case Circuit Breakers.

1.02 REFERENCES

A. As specified in Section 16050.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

C. Underwriter's Laboratories, Inc. (UL):

1. 50 - Standard for Enclosures for Electrical Equipment.

2. 67 - Standard for Panelboards.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Circuit breaker panelboards as indicated in the panelboard schedules, one-lines, and where indicated on the Drawings:

1. Service voltage and configuration as indicated on the panel schedules.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Manufacturer of panelboard.

2. Bill of material.

3. Assembly ratings including:

a. Voltage.

b. Phase.

c. Continuous current.

d. Short circuit interrupting rating.

4. NEMA enclosure type.

5. Cable terminal sizes based upon actual feeder and sub-feeder conductors used.

6. Furnish circuit breaker submittals as specified in Section 16412.

C. Shop drawings:

1. Drawings to contain:

a. Overall panelboard dimensions, interior panel dimensions, and wiring gutter dimensions:

1) Height.

2) Length.

3) Width.

b. Weight.

c. Anchoring locations.

d. Breaker layout drawing with dimensions:

1) Location of the main, branches, solid neutral, and ground.

e. Conduit entry/exit locations.

1) Identify all conduit entry/exit locations and restrictions.

f. Individual panel schedules identifying breaker locations, ratings, and nameplate designations within the panelboard, for every panelboard.

D. Installation instructions:

1. Provide anchorage instructions and requirements for the panelboard based on the seismic requirements at the Project Site as specified in Section 16050:

a. Stamped by a professional engineer registered in the state where the Project is being constructed.

E. Operations and maintenance manual:

1. Provide a complete manual for the operation and maintenance of the panelboard, circuit breakers, devices, and accessories:

a. Including but not limited to:

1) Instruction narratives and bulletins.

2) Renewal parts lists.

3) Time-current curves for all devices.

F. Calculations:

1. Detailed calculations or details of the actual physical testing performed on the panelboard to prove the panelboard is suitable for the seismic requirements at the Project Site.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Panelboards shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 WARRANTY

A. As specified in Section 16050.

1.10 SYSTEM START-UP

A. As specified in Section 16050 and Section 01750.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Eaton.

2. General Electric Company.

3. Square D Company.

B. Circuit breakers:

1. Same manufacturer as the panelboard.

2.02 EQUIPMENT

A. Provide panelboards with:

1. Molded-case circuit breakers with trip ratings as shown on the panel schedules.

2. Spares and spaces for future circuit breakers in panels as shown on the panel schedules.

B. Short circuit rating:

1. Provide panelboards with short-circuit ratings as indicated on the Drawings:

2. Testing method per UL 67.

3. Mark each panelboard with its maximum short circuit rating at the supply voltage.

4. Panelboards shall be fully rated.

2.03 COMPONENTS

A. Enclosure:

1. NEMA enclosure type as indicated on the Drawings.

a. Where not indicated on the Drawings, as specified in Section 16050 for the installed location.

2. Minimum width: 20 inches.

3. Gutter space in accordance with the NEC:

a. Minimum of 4 inches of gutter space.

4. Dead-front, no live parts when the panelboard is in service.

5. Enclose entire panelboard bus assembly in a corrosion resistant galvanized steel cabinet.

6. 4-piece front to provide ease of wiring access.

7. Lockable, hinged door over the protective devices with a flush, cylinder tumbler-type lock with catch and door pull.

a. Minimum 2 keys per panelboard.

b. Key all panelboard locks alike.

8. Circuit directory frame and card on the inside of the door.

9. Interior design such that replacement of circuit breakers does not require disturbing adjacent units or removal of the main bus connectors.

10. Provide NEMA Type 4X enclosures with a NEMA Type 4X stainless steel outer enclosure (with a hinged door) and a NEMA Type 1 interior panelboard.

B. Bus:

1. General:

a. Tin-plated copper.

2. Phase bus:

a. Full size and height without reduction.

b. Sized in accordance with UL standards to limit temperature rise on any current carrying part to a maximum of 50 degrees Celsius:

1) Limit current density to less than 1,000 amps per square inch.

c. Insulate all current carrying parts from ground and phase-to-phase with a high dielectric strength insulator.

3. Ground bus:

a. Copper, solidly bonded.

4. Neutral bus:

a. Provide where indicated on the Drawings.

b. 100 percent rated.

c. Provide lugs for each outgoing feeder requiring a neutral connection.

5. Provide insulation barriers over the vertical bus behind the dead front shield to provide increased safety during field service.

C. Lugs:

1. UL listed for copper and aluminum wire:

a. Provide lugs rated for 75-degree Celsius terminations.

b. Provide bolted or compression main lug terminations as required for the incoming cable size.

D. Circuit breakers: As specified in Section 16412 and as indicated on the Drawings:

1. Provide all circuit breakers with bolt-on connections:

a. Plug-in circuit breakers are not allowed.

2.04 ACCESSORIES

A. Surge protective devices:

1. Furnish panelboards with surge protective devices as indicated on the Drawings.

2. As specified in Section 16285.

B. Nameplates:

1. As specified in Section 16075.

2. Install on outside of door.

3. Indicating:

   a. Panel designation.

   b. Voltage.

   c. Number of phases and configuration.

4. Panel designations in 1/4-inch high letters above service voltage and configuration; for example:

19LP-1 208/120V -3PH -4W

C. Circuit identification labels:

1. Provide index cards behind heavy clear plastic in cardholders on the inside of the doors.

2. Type all information on the cards using designations in the panel schedules.

3. Laminated on both sides.

D. Pad locking mechanism:

1. Provide a pad locking attachment to allow circuit breakers to be locked in the off position.

2. At a minimum, provide one mechanism per panelboard:

   a. Provide multiple mechanisms if required to accommodate all circuit breaker frame sizes in the panelboard.

2.05 FINISHES

A. Finish stand-alone panelboards with a primer, rust-resistant phosphate undercoat, and 2 coats of oven-baked enamel with finish color ANSI 61.

B. Finish panelboards mounted in motor control centers to match the motor control center finish and color.

2.06 SOURCE QUALITY CONTROL

A. Perform standard factory tests on the panelboards:

1. Test in accordance with the latest version of NEMA and UL standards.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. Install the equipment per the manufacturer's guidelines and submitted installed instruction to meet the seismic requirements at the project site.

C. General:

1. Surface, flush or MCC mounted as indicated on the Drawings.

2. Mount rigidly to structural members with exposed surfaces plumb and level to within 1/32 inch.

3. Perform work in accordance with the manufacturer's instructions and shop drawings.

4. Provide all brackets, hangers, supports, and hardware for mounting as required.

5. In all NEMA Type 4 and NEMA Type 4X locations, mount panelboards on 7/8-inch deep stainless steel preformed channel, with channel running vertically from top to bottom of panelboard:

   a. Use only stainless steel mounting hardware.

6. Mount panelboard so that top operating handle is not more than 6 feet-7 inches above the operating floor.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Provide Field Acceptance Testing per Section 16950 and Section 01750.

3.03 CLEANING

A. Refer to Section 17050.

3.04 DEMONSTRATION AND TRAINING

A. Refer to Section 17050.

3.05 PROTECTION

A. As specified in Section 16050.

3.06 SCHEDULES

A. Circuiting within the panelboard shall match the panel schedules as indicated on the Drawings.

B. Provide typewritten removable schedule in each panelboard.

END OF SECTION

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SECTION 16494

LOW VOLTAGE FUSES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Fuses: 600 volt class and lower.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. As specified in Section 16050.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Fuses for overcurrent protection and/or current limiting applications as indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Catalog cut sheets.

2. Complete fuse schedule.

3. Manufacturer original 11-inch by 17-inch, time current curves for all fuses furnished.

C. Shop drawings:

1. Include drawings of spare fuse cabinets.

D. Operation and maintenance manuals:

1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration:

a. Including factory calibration for each instrument with stated accuracy.

2. Complete installation, calibration, and testing manuals.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. All low voltage fuses shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 WARRANTY

A. As specified in Section 16050.

1.10 SYSTEM START UP

A. As specified in Section 16050.

1.11 MAINTENANCE

A. Spare parts:

1. Provide 3 spare fuses for each size and type used or supplied per each panel, MCC, vendor panel, and equipment provided under any Section of the Contract Documents.

2. Provide 3 spare fuses for each size and type used or supplied per fused disconnect switch.

3. Provide low voltage fuse cabinet for each building and house all spare low voltage fuses associated with that building's panels, vendor panels, equipment:

a. Metal cabinet with hinged door and shelves or fuse holders.

b. Gray enamel finish.

c. Mount per OWNER and label "Spare Fuses" on face of cabinet.

d. Suitable pocket inside door of each cabinet with typewritten spare fuse inventory in clear plastic protective insert. Provide panel name and fuse type and size on visible end of fuse box.

e. Provide as many cabinets as required to hold entire spare fuse inventory for that specific building.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following, or equal:

1. Ferraz Shawmut.
2. Littelfuse.
3. Bussmann.

2.02 MANUFACTURED UNITS

A. General:

1. Provide durable, readily visible label inside each fuse enclosure, clearly indicating the correct type, size, and ratings of replacement fuse:
   a. Label shall not cover or interfere with equipment manufacturer's instructions.
2. Affix a label indicating recommended torque for fuse mounting bolts or studs to the inside of fuse access doors.
3. To assure selective coordination of protective devices:
   a. Provide fuses for new facilities by the same manufacturer.
   b. Provide fuses for renovations of the same manufacturer as existing fuses.
4. Provide fuses rated for the voltage and available short circuit current at which they are applied.

B. Fuses for services, switchboard mains, feeders, and branch circuits:

1. 600 amperes and less:
   a. Provide UL listed RK1 dual-element, time-delay fuses with ampere ratings as indicated on the Drawings except as may be modified by the Contract Documents.
2. 601 to 6,000 amperes:
   a. Provide UL listed Class L fuses.

C. Fuses for motor branch circuits:

1. Ampere ratings shall not exceed motor controller manufacturer’s recommended values:
   a. If manufacturer does not have such standards, provide fuses as specified in this Section.
2. Provide Class RK1 fuses or fuses as indicated on the Drawings and as specified in the Contract Documents, rated in accordance with the fuse manufacturer’s recommendations for backup running protection of motor circuits containing overload relays.
3. Determine fuse ratings for overload protection of motor branch circuits by actual full-load currents of motors provided.

4. Fuses in motor control centers may be time-delay Class J or Class CC fuses, if MCC manufacturer's standard designs use these fuse types:

   a. Time-delay Class J fuse ratings shall not exceed 150 percent of motor full load current except as permitted.

   b. Follow fuse manufacturer's recommendations for Class CC fuses.

   c. A motor having starting duty or other special characteristics requiring larger fuses than specified above, may have branch circuit fuse ratings increased as necessary to meet motor's requirements, but no larger than maximum permitted by the NEC.

      1) Increased requirements for an individual motor shall not be cause for increasing size of all fuses.

5. Provide Class L fuses for motor branch circuits requiring fuses over 600 amperes, sized at 150 percent of motor full load current except as permitted below:

   a. A motor having starting duty or other special characteristics requiring larger fuses than specified above, may have branch circuit fuse ratings increased as necessary to meet motor's requirements, but no larger than maximum permitted by the NEC.

      1) Increased requirements for an individual motor shall not be cause for increasing size of all fuses.

D. Fusing of control circuits:

1. Provide:

   a. Time-delay Class CC fuses installed in UL listed Class CC fuse blocks as specified in the Contract Documents.

2. Provide minimum protection for control circuits in accordance with the latest revision of UL Standard 508 for Industrial Control.

3. Fuse both the primary and secondary circuit of control power transformers:

   a. Fuse ratings shall be in accordance with NEC requirements.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 16050.

B. General:

1. Install fuses properly aligned, electrically and mechanically secure.

2. Evenly torque mounting bolts and nuts to ASTM recommendations for type and diameter of mounting bolts or studs provided.

3. Paralleling of fuses is not permitted.

4. Install fuses so that the fuse nameplate and rating are easily readable in the equipment.

C. Replace fuses, on all phases, for any fuses that opened during startup and testing.

D. After completion of testing, deliver spare fuses in quantities specified:

1. Fuses shall be new, in manufacturer's original packaging, and stored in a clean, dry location.

2. Install spare low voltage fuse cabinets where instructed by the OWNER.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050 and Section 01750.

3.03 CLEANING

A. As specified in Section 16050.

3.04 PROTECTION

A. As specified in Section 16050.

END OF SECTION

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SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Luminaires, lamps, ballasts, poles, and accessories.
2. This specification applies to automatically-controlled interior and exterior Lighting Control system as specified.
   a. Lighting Control System supplied shall be complete system including: design, layout, supply, installation, testing, startup, and training.
   b. Provide all necessary equipment and hardware for a complete and operable Lighting Control System. Not all equipment is shown on Drawings.
3. This specification applies to photocell controlled exterior Lighting Control Panels as specified and shown on Drawings.
4. The Drawings and Specifications are not intended to be a complete listing of all components required for the system. All auxiliary and accessory equipment necessary for system performance in compliance with the applicable codes shall be provided even if not specifically detailed on the drawings or in these specifications. Preparation, design and submittal of detailed, project-specific installation drawings (including but not necessarily limited to mounting, interconnection, wiring type details, supportive calculations, etc.) shall be included as a part of this work.
5. CONTRACTOR shall coordinate location of light fixtures and mounting heights as not to interfere with other equipment, piping, etc. ENGINEER to approve final lighting fixture positions and mounting heights as determined by the CONTRACTOR based on equipment supplied and installation and routing of materials.
6. CONTRACTOR is responsible for submitting for approval professional Engineer stamped and signed anchoring calculations and anchoring plate designs for pole mounted fixtures.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR

to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. As specified in Section 16050.

B. American National Standards Institute (ANSI):

1. C62.41 - Recommended Practice for Surge Voltage in Low-Voltage Ac Power Circuits.

2. C82.11 - High Frequency Fluorescent Lamp Ballast.

3. C82.77 - Harmonic Emission limits - Related Power Quality Requirements for Lighting Equipment.

C. Underwriters Laboratories (UL):

1. UL 935 - Fluorescent Lamp Ballasts.

2. UL 1570 - Fluorescent Lighting Fixtures.

D. Lighting control devices shall be certified by the California Energy Commission (CEC) and listed in the "Directory of Automatic Lighting Control Devices."

E. All panels shall use UL listed components and shall be manufactured and assembled in accordance with UL Standard 508.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions and abbreviations:

1. BF: Ballast factor - Measure of light output from lamp operated by commercial ballast as compared to a laboratory standard reference ballast.

2. BEF: Ballast efficacy factor - Value used to evaluate various lighting systems based on light output and power input.

3. CCT: Correlated color temperature - Scientific scale to describe how “warm” or how “cool” the light source is, measured in Kelvin.

4. Crest factor - ratio of peak lamp current to RMS or average lamp operating current.

5. Efficacy - Lumen output per unit of power supplied to ballast (lumens per watt).

6. EMI: Electromagnetic Interference - Electrical interference (noise) generated by electrical and electronic devices.

7. FC: Foot Candles - Measure of light level on a surface being illuminated.

8. Instant start - Lamp starting method in which lamps are started by high voltage input with no preheating of lamp filaments.

9. Luminaire - Lighting unit.

10. Programmed start - lamp starting method that utilizes an integrated circuit to preheat the lamp filament while not allowing the lamp to ignite and then applies the open circuit voltage to start the lamp.

11. Rapid start - Lamp starting method in which lamp filaments are heated while open circuit voltage is applied to facilitate lamp ignition.

12. THD: Total harmonic distortion - The combined effect of harmonic Distortion on the AC waveform produced by ballast or other device.

1.04 SYSTEM DESCRIPTION

A. Provide luminaires, and accessories for all lighting systems, complete and operable, in accordance with the requirements of the Contract Documents.

B. Individual luminaire types are indicated on the Fixture Schedule.

C. The equipment specified shall implement the following mandatory controls as required by California Energy Commission Building Energy Efficiency Standards and as shown on the Drawings.

1. Dual level manual lighting control.

2. Manual dual level daylight control.

3. Automatic dual level daylight control.

4. Exterior light photocell control.

D. Provide and design Lighting Control Systems for building interior spaces and exterior of building where specified and as shown on Contract Drawings. Lighting Control System shall be integrated assembly for a complete working system. Lighting Control System supplier is responsible for design, layout, furnishing of materials, interconnection diagrams, mounting details, configuration, testing and training.

E. The equipment shall include Lighting Control Panels (LCP's) for exterior lighting complete with photocell, control switches, contactors, labeling, etc. The LCP's shall be fully factory assembled and tested by UL 508 shop. LCP to be located within Motor Control Center. Provide LCP's at the following locations:

1. Shasta Park Water Facility.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Product data:

1. Luminaires:

a. Catalog literature for each luminaire specified, cross-referenced to the luminaire type on the Fixture Schedule in the Drawings.

b. Provide for each luminaire type:

1) Materials.

2) Type of diffuser.

3) Hardware.

4) Mounting details.

5) Gasketing.

6) Reflector.

7) Chassis.

8) Finish and color.

9) Ballast type and protection.

10) Lamp:

a) Type.

b) Wattage.

c) Lumen output:

(1) Initial.

(2) Mean.

d) Correlated color temperature.

e) Lamp lumen depreciation.

f) Efficacy.

g) Base.

11) Picture of luminaire.

12) Dimensioned drawings:

a) Effective projected area rating for pole mounted luminaires.

13) Weight.

14) Photometric data:

a) Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.

b) Luminaire dirt depreciation factor.

c) Candlepower distribution curves.

d) Average luminaire brightness.

e) Lumen output charts.

15) Furnish mounting details for luminaires weighing more than 30 pounds and all wall-mounted luminaires:

a) Support methods shall be based on seismic requirements at the project site as specified in Section 16050.

c. Luminaire substitutions:

1) Provide complete literature for each luminaire substitution.

2) Submittals for substituted luminaires shall be sufficient for competent comparison of the proposed luminaire to the originally specified luminaire:

a) Photometric data:

(1) IES file in standard IES format.

(2) Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.

(3) Candlepower distribution curves.

(4) Average luminaire brightness.

(5) Lumen output charts.

(6) Power requirements in watts and volt-amperes.

b) Calculations:

(1) Provide software generated calculations showing illuminance levels in footcandles and power usage in watts per square foot for each of the areas in which substitutions are proposed:

(a) Use surface reflectance values and luminaire light loss factors approved by the ENGINEER to perform all calculations.

3) Substitutions for specified luminaires will be evaluated upon quality of construction, light distribution, energy use, appearance, and maintenance.

4) Substitutions shall comply with all applicable building codes.

2. Ballast:

a. Provide for each ballast type:

1) Type of ballast.

2) Lamp wattage.

3) Input voltage.

4) Input watts.

5) Starting line current.

6) Operating line current.

7) Sound rating.

8) Power factor.

9) Ballast factor.

10) Starting temperature.

3. Photocell:
    a. Provide for each photocell type:
        1) Switching capacity.
        2) The means of adjusting the lighting pickup level.
        3) Enclosure type.
        4) Mounting method.
4. Lighting Control System components complete:
    a. Switching systems:
    b. LCD panel processor.
    c. Low voltage wall stations (switches).
    d. Low voltage control interfaces.
    e. Ceiling mounted occupancy sensors.
    f. Ceiling mounted occupancy sensors with photocell.
    g. Wall mounted occupancy sensors.
    h. Wall mounted occupancy sensors with photocell.
    i. Wall mounted occupancy sensors with 120-foot linear coverage.
    j. Wall mounted occupancy sensors with 120-foot linear coverage with photocell.
    k. Low voltage wiring.
5. Lighting Control Panel components complete:
    a. Contactors.
    b. Photocells
    c. Control switch.
    d. Enclosure.
    e. Wiring schematic.
6. Luminaire poles:
    a. Submit complete data for each pole type including but not limited to:
        1) Material.
        2) Finish and color.
        3) Handholes.
        4) Anchoring.
        5) Luminaire attachment methods and fittings.
        6) Pole height.
        7) Pole dimensions.
        8) Bolt hole circle layout, and hardware.

9) Accessories.

10) Provide the EPA wind load rating.

C. Shop drawings:

1. Load schedules indicating actual connected load, load type, and voltage per circuit.

2. Circuits and their respective control zones, including capacity and phase.

3. Control system I/O assignments.

4. Schematic of systems.

5. Equipment layout drawings.

6. Wiring and conduit layout drawings.

7. Conduit and cable schedules.

8. Configuration hard copy print out for Lighting Control Systems.

D. Calculations:

1. Provide complete design calculations and installation documents for pole mounting piers and poles mounted from structures:

a. Include in the calculations the wind and seismic requirements at the project site.

b. Calculations and design shall be performed by and signed by a structural Professional Engineer registered in California:

1) Because this design is being provided by a Professional Engineer, the submittal will be reviewed for form and content but not reviewed for technical completeness, methods, or calculations.

2) Calculations may be provided by manufacture, but still require Professional Structural Engineer stamp and signature.

E. Field Testing and Results as part of General Start-Up and Testing Procedures:

1. Field Acceptance Test procedures and forms.

2. Field Acceptance Test results.

3. Certified statement of readiness for the Lighting Control Systems.

F. Record documents:

1. Update the Fixture Schedule in the Drawings to reflect the acceptable substitutions, after the substitution has been reviewed and accepted by the ENGINEER.

2. Provide as-built drawings in AutoCAD and PDF formats for lighting control system.

3. Operating and Maintenance Manuals as specified in 01780.

G. Warranties

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Manufacturer's service personnel shall perform all tests, inspections, and adjustments required by the manufacturer and as specified in this section. Manufacturer's service personnel shall report to the job-site with any test equipment and special tools as required and specified.

C. Provide a factory-certified field service engineer to ensure proper Lighting Control System installation, configuration and operation. Provide as many site visits as are required to accomplish this objective. The factory-certified field service engineer shall perform the following:

1. Pre-installation:

   a. Familiarize the electrical contractor with the wiring and mounting requirements for all devices in the Lighting Control System prior to any equipment or wiring/conduit infrastructure installation.

   b. Review the electrical contractor's proposed conduit and wiring layouts and equipment locations, and schedules. Coordinate any necessary changes as required through the Engineer.

2. Start up and Operation:

   a. Verify proper connection of power feeders and branch circuit wiring.

   b. Verify proper connection of sensors and network connected devices.

   c. Verify proper connection and location of controls for Lighting Control System.

   d. Energize the control panel and download the approved Lighting Control System configuration.

   e. Adjust sensitivity of occupant sensors as required.

   f. Relocate sensors as required.

   g. Set the I/O addresses for all Lighting Control System components.

   h. Verify system operation control by device, and circuit by circuit. Make adjustments to configuration as required by OWNER and ENGINEER.

   i. Verify proper operation of the Ethernet TCP/IP interface to Plant Control Network.

3. Post Installation Adjustment and Training:

   a. Fine tune the system and address punch list items after an initial period of use. This shall be performed prior to completion of General Start-Up and Testing Procedures phase. Refer to Section 01750.

   b. Adjust sensitivity of occupant sensors as required.

   c. Provide training as described below.

D. Statement of readiness: following completion of the field inspections, adjustments, and tests, the manufacturer's service personnel shall submit a signed statement to the Engineer stating that the lighting control system has been properly installed, adjusted, and tested, and is ready for energization.

E. Training:

1. Training shall be by the manufacturer's qualified representative and shall include instruction on complete service, operation, and maintenance of the lighting control system as recommended by the manufacturer.

2. The bid shall include the number of training sessions specified in Section 16050.

F. Equipment shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SCHEDULING

A. Exterior and outdoor lighting system operation shall be demonstrated during the hours of darkness.

B. Lighting demonstration shall occur prior to completion of General Start-Up and Testing Procedures.

1.10 WARRANTY

A. As specified in Section 16050.

1.11 SYSTEM START UP

A. As specified in Section 16050 and Section 01750.

1.12 SPARE PARTS

A. Replace all lamps used during construction.

B. Spare ballasts: Furnish 5 percent of the quantity ballasts provided, but not less than 2 ballasts for every ballast type and size used.

C. Spare lamps: Furnish 10 percent of the quantity lamps provided, but not less than 4 new lamps for every lamp type and size used.

D. Spare pole photocells: Furnish two pole mounted photocells for each type provided.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Luminaires: One of the following or equal:

1. As noted on the Fixture Schedule.

B. Lamps: One of the following or equal:

1. General Electric Company.
2. Osram Sylvania.
3. North American Philips Lighting Company.

C. Contactors for exterior only Lighting Control Panels: One of the following or equal:

1. ASCO.

D. Photo-electric cells: One of the following or equal:

1. Intermatic Model 4221C.
2. Tork.
3. Paragon Electrical Products.

E. Wall mounted occupancy sensors: One of the following or equal:

1. Lutron Electronics Company, Model LOS-WDT-R-WH with PP-120H power pack.
2. Hubbell Wiring Devices, Model ATD1600W with CU120A control unit.

F. Wall mounted occupancy sensors with photocell: One of the following or equal:

1. Hubbell Wiring Devices, Model ATD1600WRP with CU120A control unit.

G. Wall mounted occupancy sensors with 120 foot linear coverage: One of the following or equal:

1. Hubbell Wiring Devices, Model ATP120HB with CU120A control unit.

H. Wall mounted occupancy sensors with 120 foot linear coverage and photocell: One of the following or equal:

1. Hubbell Wiring Devices, Model ATP120HBRP with CU120A control unit.

I. Wall mounted outdoor motion sensor: passive infrared with microwave detection, IEC-IP 54 rated, vandal resistant, built-in adjustable timer, 24VDC, -40 to 130°F operating temperature, with Form C relays. One of the following or equal:

1. Bosch OD850

J. Wall mounted outdoor motion sensor: 180 degree coverage, IEC-IP 55 rated, 120VAC, -40 to 130°F operating temperature, with isolation relay. One of the following or equal:

1. Watt Stopper EW-100-120

K. Substitutions:

1. The lighting design and luminaire selection has been based upon the photometric data of the identified luminaire. It is the CONTRACTOR's responsibility to ensure and prove to the ENGINEER at time of submittal the substitutions meet the quality and photometric requirements of the original design.

2.02 EQUIPMENT

A. Luminaires:

1. General:

a. Pre-wired with leads of #18 AWG, minimum, for connection to building circuits.

b. Provide the luminaires furnished per the Fixture Schedule in the Drawings:

1) The Specifications noted herein are an addition or supplement to the Fixture Schedule.

2. Exterior/outdoor luminaires:

a. Luminaires in combination with their mounting pole and bracket shall be capable of withstanding:

1) Wind levels at the project site without damage.

2) Seismic levels at the project site.

b. Corrosion-resistant hardware and hinged doors or lens retainer.

c. Provide receptacles, switches with weatherproof covers where required on Fixture Schedules or called out on Drawings.

d. Luminaires furnished with integral photoelectrical control shall be of the luminaire manufacturer's standard design.

e. California Energy Code Light Pollution Reduction Compliance:

1) Provide all exterior luminaires with cutoff photometrics and shields per Fixture Schedule.

2) Provide exterior luminaires with photocells to automatically control exterior lighting dusk to dawn to turn off. Reference the Drawings for specific luminaires to be controlled.

B. Lamps:

1. General:

a. Provide lamps as indicated on the Fixture Schedule.

b. Lamps selected to mate with luminaires selected.

c. Suitable for operation in any burning position unless otherwise indicated in the Contract Documents.

2. LEDs:

a. Wattage indicated on the Fixture Schedule.

b. High output white LEDs with 50,000 hours life expectancy maintaining minimum of 70% initial value output.

c. Provide LEDS per IESNA RP-8 standard for roadway and site lights.

C. Photo-electric cells:

1. Photoelectric cells for control of multiple luminaires:

a. Self-contained.

b. Weatherproof.

c. Provided with time-delay features.

d. Sized to meet switching capacity of the circuit:

1) Based on ballast VA as indicated on the Drawings.

2. Photoelectric cell for control of a single luminaire:

a. Plug type as provided by luminaire manufacturer with matching receptacle.

D. Ballasts:

1. General:

a. Energy saving type suitable for use with energy saving lamps where available and compatible for Lighting Control System design.

b. Suitable for operation over the entire temperature range specified in Section 16050 for all luminaires not located in office areas or air conditioned spaces.

c. Meet FCC standard, Class A for EMI/RFI (FCC 47FCR Part 18 Non-consumer equipment).

d. Comply with applicable ANSI/IEEE standards/guidelines for harmonic distortion and line voltage transient protection.

E. Lighting Control System:

1. Provide Lighting Control System as indicated on the Drawings and designed by Lighting Control System supplier. Lighting Control System supplier shall be responsible to provide Lighting Control System designs complete including equipment layouts, sensor type and location, conduit and cable diagrams, interconnection diagrams, equipment plans, network cable specifications, conduit sizing, calculations, testing, start-up and OWNER training.

2. Lighting Control System and connected luminaire ballast type shall be coordinated and approved by Lighting Control System supplier.

3. Lighting Control System Switching Systems Mechanical:

a. Listed to UL 508 as industrial control equipment, delivered and installed as a UL listed factory assembled panel consisting of power panels, control stations, occupancy sensors, and photocells.

b. Field wiring shall be accessible from the front of the panel without need to remove components.

c. Panels shall be passively cooled via free convection without the use of fans.

d. Provide jumper bars rated for the full-load current of each circuit for relay bypass operation.

e. Panels shall be surface mounted unless otherwise shown on the Drawings.

4. Lighting Control System Switching Systems Electrical:

   a. Provide panel voltage as follows: 120/208 VAC, three-phase, four-wire.

   b. Provide main lugs for the incoming feeder unless otherwise shown on the Drawings. The panel shall be rated for 100 amperes.

   c. Panels shall contain branch circuit protection for each circuit unless otherwise shown on the Drawings.

   d. Provide branch circuit breakers as follows:

      1) Listed to UL 489 as a molded case circuit breaker for use on lighting circuits (SWD rated).

      2) 20 amperes or 30 amperes, single-pole, thermal-magnetic type, with visual trip indicator, rated for 10 kAIC short-circuit current, and capable of accepting a lockout/tagout device.

      3) Replaceable without moving or replacing dimmer/relay assemblies or other components in the panel.

      4) Provide a minimum of 18 branch circuit breakers in the panelboard unless otherwise shown on the Drawings.

   e. The panel shall have a minimum UL listed Short Circuit Current Rating (SCCR) of 22,000 A.

   f. Circuit breakers and relays shall be fully rated, capable of continuous duty for any combination of inductive, capacitive, and resistive loads.

5. Low-voltage wiring:

   a. Low-voltage communication wiring shall be as approved by the manufacturer. Non-approved types are not acceptable.

   b. Provide communication link terminators at the start and end of the network.

6. Provide all controls, hardware, sensors, power supplies, voltage sources, conduits, cables, configuration, etc. for a complete and operable Lighting Control System.

2.03 COMPONENTS

A. Luminaire poles:

   1. As indicated on the Fixture Schedule.

   2. Provide modifications at existing poles near State Building as required for installing new fixtures on existing poles with photocell controls.

   3. Anchor Bolts:

      a. Use anchor bolts, bolts, or welded studs for anchors for resisting seismic and wind forces.

         1) Standard hex bolt head.

      b. Complete with leveling shims.

4. Anchor base:

   a. Per pole manufacturer's recommendation.

   b. Provide specialty anchor base plates design, calculations and fabrication for light poles where identified on Contract Drawings.

   c. Provide specialty anchor base plate design, calculations, and fabrication for light poles on concrete decks.

   d. CONTRACTOR responsible for seismic calculations based on anchoring of specialty anchor plates as designed by lighting supplier. Calculations shall include anchor type, dimensions, and material. Submit anchoring plate and calculations for approval.

5. Pole shaft:

   a. As indicated on the Fixture Schedule.

6. Pole Handhole:

   a. Handhole located approximately 18 inches above the base, mounted to side of pole.

   b. Complete with cover fabricated from the same material as the pole shaft and stainless steel attachment screws.

   c. With an integral ground connection nut, 1/2 inch by 13 inch UNC welded to the pole for connection to the grounding system.

7. Pole Receptacles and Switches:

   a. Provide pole mounted receptacles and switches as required per Fixture Schedule. Provide weatherproof housings.

   b. Locate receptacle as part of pole handhole, otherwise on opposite side of pole located 18 inches above the base.

   c. Locate switch on pole front approximately 48 inches above the base.

8. Shroud:

   a. Fabricated from the same type of material as the pole shaft.

   b. Secured by a locking device with provisions for a padlock to prevent accidental lowering.

9. Fastening hardware:

   a. All fasteners shall be stainless steel.

10. Finish:

   a. As indicated on the Fixture Schedule.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Install luminaires per the manufacturer's guidelines and submitted installation calculations to meet seismic and wind requirements at the project site.

C. Special techniques:

1. Support luminaires from structural elements capable of carrying the total weight.

2. Install luminaires plumb and square with building and wall intersections:

a. Suspend pendant-mounted luminaries that are mounted from sloping ceilings with ball hangers, unless otherwise indicated on the Drawings.

b. Install luminaires in machinery rooms after machines have been installed, so as to ensure no conflict with machinery, piping, or duct work.

3. In all cases, coordinate luminaire locations with work of other trades to prevent obstruction of light from the fixtures:

a. Locate bottom of luminaire approximately at the bottom of ductwork or piping, unless otherwise specified or indicated on the Drawings.

4. Support luminaires weighing more than 25 pounds independently of the outlet box and the conduit.

D. Photocells shall be mounted facing north and in a location that is unaffected by light fixture sources.

E. Panels shall be firmly bolted to the appropriate surface in accordance with the approved shop drawings.

F. Provide equipment anchorage in accordance with the approved seismic calculations.

G. Lighting Control System:

1. Do not route low-voltage communication wiring for the lighting control system in the same conduit as AC power conductors. Run low-voltage communication wiring in separate conduits as designed by Lighting Control System supplier.

2. All low-voltage communication wiring for the Lighting Control System shall be supplier's submitted and approved interconnection diagrams. Follow the manufacturer's recommendation for shield termination.

3. Follow the manufacturer's recommendations for maximum network length.

4. Install occupant sensors so that they have unobstructed views of the room or area servicing. Do not install where there is airflow - e.g., adjacent to HVAC outlets, windows, fans, or similar.

H. Luminaire poles:

1. Set poles on anchor bolts and secured with double nuts on each bolt.

2. Dry-pack the pole base, after the luminaire and pole has been leveled and plumbed.

3. Bond metal poles to the plant grounding system, utilizing a ground lug connection within the pole

3.02 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Lighting Control System:

1. All Field Acceptance Testing, as part of the General Start-Up and Testing Procedures in Section 01750; shall be witnessed by and signed off by the ENGINEER and the Lighting Control System suppliers' designer.

2. The CONTRACTOR shall furnish any special tools, equipment, and labor to perform the tests.

3.03 ADJUSTING

A. Aim and verify all exterior and outdoor luminaires alignment, during dark evening hours, as directed by OWNER or the ENGINEER.

3.04 CLEANING

A. As specified in Section 16050.

B. Clean all lenses, diffusers, and reflectors.

C. Refinish all luminaire's trim, poles and support brackets, where finish has been damaged.

D. Clean and re-lamp all luminaires (new and old), used during construction for construction lighting, before substantial completion.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 16050 and Section 01750.

1. Perform the lighting demonstration, in accordance with this Section, witnessed by the OWNER and the ENGINEER. The entire lighting system shall be observed to verify luminaires are properly focused and aimed.

2. Switching functions are in accordance with the Contract Documents and approved Lighting Control System suppliers' design and verify all:

a. Photocell operation.

b. Time clock operation.

c. Programmable lighting control operations.

d. Switching operations.

e. Dimming operations.

f. Motion control operations.

B. Training:

1. Provide instruction of the OWNER's operation and maintenance staff on the operation and maintenance of the lighting system.

2. Separate classes are required for the operations staff and maintenance staff:

a. Operations staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session

lasting 2 hours. Total Operations training time is 4 hours (2 classes of 2 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all operators have the opportunity to attend.

b. Maintenance staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 4 hours. Total Maintenance training time is 8 hours (2 classes of 4 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all maintenance staff has the opportunity to attend.

c. Instruction shall occur at the OWNER's facility and shall utilize the actual lighting systems installed at the site.

C. Refer to Section 01750 for further training requirements.

3.06 PROTECTION

A. As specified in Section 16050.

3.07 SCHEDULES

A. Refer to the Fixture Schedule in the Drawings.

END OF SECTION

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SECTION 16710

FIRE ALARM AND SMOKE DETECTION SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Design, supply and installation of a complete addressable type fire alarm system to interface with City Standard Fire Alarm Panel.

2. Not all required Fire Alarm system components are shown on the Drawings. Fire Alarm System supplier is responsible for design and approval of complete and operable system.

3. Fire alarm Systems supplier shall provide and be responsible for:

a. Design of Fire Alarm System including quantities of equipment, layout drawings, and equipment material lists. Include conduit and cable interconnection drawings.

b. Coordination with HVAC duct type smoke detectors for network communication and additional dry contact to local PLC Panel as required.

c. Design approval from local agency having authority.

d. Verification of Installation.

e. Start-up, testing and training.

f. Equipment including:

1) Initiating Devices.

2) Notification Appliances.

3) Fire Alarm Control Panels.

g. Hardware and software additions, configurations, programming, firmware upgrades, and all necessary equipment for a complete and operable system. City Standard is Simplex 4000 series.

4. Provide for Fire Alarm System comprised of Fire Alarm Control Panel, initiating devices, and notification appliances; at the Shasta Park Water Facility.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

   a. Section 01330 - Submittal Procedures.

   b. Section 16050 - Common Work Results for Electrical.

   c. Section 16123 - 600 Volt or Less Wires and Cables.

C. Utilize a single Fire Alarm System Supplier (FASS) to design, furnish, and install all materials, equipment, labor, and services required to achieve a fully integrated and operational fire alarm system, in complete compliance with the NFPA Class and Style specified and designed.

D. Coordinate the Fire Alarm System with related equipment and materials furnished under other sections of these Specifications.

E. Coordinate with the existing Fire Alarm System equipment so that the final expanded system will operate as a single Fire Alarm System. Provide for fiber optic communication networked connection to the existing Fire Alarm System. Provide for all required transceivers. Power for fiber optic communication transceivers shall come from battery backed up Fire Alarm panel sources.

1.02 REFERENCES

A. As specified in Section 16050.

B. National Fire Protection Association (NFPA):

   1. 72 - National Fire Alarm Code.

   2. 72E - Automatic Fire Detectors.

   3. 90A - Installation of Air Conditioning and Ventilating Systems.

   4. 101 - Life Safety Code.

C. Local Jurisdiction Adopted Codes and Standards.

D. Factory Mutual (FM).

E. Underwriters Laboratories (UL):

   1. UL 268 - Smoke Detectors for Fire Alarm Signaling Systems.

   2. UL 864 - Control Units and Accessories for Fire Alarm Systems.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. Provide a complete, non-coded, addressable, microprocessor-based Fire Alarm System with initiating devices, notification appliances, and controls and supervisory devices as indicated on the Drawings and as specified herein.

1. System connections for initiating (signaling) circuits and notification appliance circuits shall be designed and furnished by Fire Alarm System Supplier.

2. Provide hardwired alarms from Fire Alarm Control Panel and smoke detectors (where shown on Contract Drawings) to local PLC Panels for interface into SCADA system.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 16050.

B. Product Data:

1. Data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification including electrical characteristics such as voltage and current ratings, connection requirements, software and firmware versions and operational details of all equipment.

2. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this Specification.

C. Shop Drawings:

1. Fire detection system block diagram.

a. Fire detection functions and control interconnections for each building as described herein, and as indicated on the Drawings.

b. Fire Alarm Control Panel layout, schematic, and wiring diagrams, panel displays, and LED arrangement.

c. Detection device type, features, setpoints, addresses and physical locations.

d. Number and size of wires, type of wire insulation required for devices specified, and conduit size for proposed circuits.

2. System power and battery charts with performance graphs and voltage drop calculations to assure that system will operate per the specified backup time periods and under all voltage conditions per UL and NFPA standards.

3. Include details of equipment assemblies and support requirements. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.

4. Field Acceptance Test procedures and forms as part of General Start-Up and Testing Procedures.

5. Field Acceptance Test results indicating satisfactory completion of required tests and inspections.

6. System Fire Alarm System layouts on floor plan drawings, drawn to scale using AutoCAD 2010 software.

7. Location diagrams for all HVAC ventilation duct mounted smoke detectors and corresponding ventilation system shutdown interlocks. Where required.

8. Fire Alarm System Panel input-output point list, addresses, component listing.

9. Spare parts list for extra materials being furnished.

D. Operating and Maintenance Manuals as specified in 01780. Include the following in the Operating and Maintenance Manuals:

1. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

2. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.

3. Complete wiring diagrams showing connections between all devices and equipment.

4. Riser diagram.

5. Record copy of site-specific software.

6. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

a. Equipment tested.

b. Frequency of testing of installed components.

c. Frequency of inspection of installed components.

d. Requirements and recommendations related to results of maintenance.

e. Manufacturer's user training manuals.

7. Manufacturer's required maintenance related to system warranty requirements.

8. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

E. Name of Fire Alarm System supplier and verification that fire detection and mechanical HVAC systems and Security systems have been coordinated where applicable.

F. Manufacturer's installation instructions for each device.

G. Fire Alarm System suppliers' designers and installers qualifications.

H. Submit the equipment layout drawings and product data to the local authority having jurisdiction (AHJ) for review and approval of the proposed Fire Alarm Systems.

1. CONTRACTOR is responsible for paying plan check, permit and inspection fees as necessary.

2. Submit AHJ's approval to ENGINEER.

I. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.

J. Sample warranty.

1.06 QUALITY ASSURANCE

A. Refer to Section 16050.

B. Fire Alarm System Supplier's Designer Qualifications:

1. Designer of similar installations for a minimum of 5 years with a satisfactory performance record.

C. Manufacturer Qualifications: Manufacturer of proposed system for a minimum of 10 years with satisfactory performance record.

D. Fire Alarm System Installer Qualifications: Manufacturer approved installer of products similar to specified products on a minimum of 5 projects of similar scope as this project with a satisfactory performance record.

E. Installation to be supervised by NICET Level II Technician.

F. Fire alarm systems shall be UL approved.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

B. Existing Fire Alarm system is Simplex 4100 series with existing Simplex 4010 control panels installed in 2003, typical for SRWTP and EAFWTP.

1.09 SEQUENCING

A. Submit plans to AHJ for approval.

B. Make submittals, including AHJ's approval to the ENGINEER.

C. Existing fire alarm equipment shall be operational while interfacing with new equipment.

1.10 WARRANTY

A. As specified in Section 16050.

B. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1.11 SYSTEM START-UP

A. Refer to Section 16050 and Section 01750.

1.12 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Fire Alarm Systems: One of the following or equal:

1. Simplex Grinnell.

2.02 EQUIPMENT

A. Provide the Fire Alarm System with all necessary hardware and software to perform the following functions:

1. Fire alarm and detection operations.

a. Provide all required network interface modules, fiber optic communication transceivers, relay modules, and zone modules for interconnections as required and specified herein.

2. Control and monitoring of duct mounted smoke detectors, heat detectors, smoke detectors, and other equipment as indicated in the Specifications or as indicated on the Drawings.

3. Interface with Access Security System as required for gate operation.

4. Annunciation:

a. Operation of alarm and supervisory initiating devices shall be annunciated at the building's FACP, indicating the location and type of device.

b. Signal Transmission:

1) Alarms from the FACP shall be routed to

a) Local Plant PLC Panel for hardwired alarm status.

2) Communication from the FACP shall be routed to existing Master Fire Alarm Panel.

a) Via local plant PLC Panel with fiber communication.

b) Provide fiber media modules at existing Master Fire Alarm Panel.

5. System general alarm sequence:

a. Indication of alarm condition at the FACP.

b. Identification of the device that is the source of the alarm at the FACP.

c. Operation of audible and visible notification devices throughout the building until silenced at FACP.

d. Interfacing with HVAC system for proper operation and shut down of HVAC equipment.

e. Signaling the existing Master Fire Alarm Panel for notification of the local fire department.

6. Alarm Silencing:

a. When the “Alarm Silence” button is pressed, all audible alarm signals turn off.

7. System Reset:

a. Provide a system reset button that returns the system to its normal state.

b. Display messages providing operator assurance of the sequential steps as they occur.

c. The system shall verify all circuits or devices are restored before resetting the system to avoid the potential for re-alarming the system.

d. Should an alarm condition continue, the system remains in an alarmed state.

8. Recording of Events:

a. History Logs:

1) Provide a means to recall alarms and trouble conditions in chronological order for recreating an event history. Provide a system with a separate alarm and trouble log.

2.03 COMPONENTS

A. Fire Alarm Control Panels (Nodes):

1. Power Requirements:

a. 120 VAC input power via a dedicated circuit.

b. Battery system:

1) Provided with sufficient battery capacity to operate the entire system upon loss of normal 120 VAC power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period.

2) The system shall automatically transfer to battery standby upon power failure.

3) Provide automatic battery charging and recharging operations.

4) Supervise the system batteries so that a low battery condition or disconnection of the batteries indicates a trouble at the FACP.

5) Battery Charger with battery volt meter and ammeter.

c. All circuits requiring system operating power shall be 24 VDC with individual fuses at the FACP.

d. Supervise the incoming power to the system so that any power failure will be indicated at the control unit.

1) A green "power on" LED shall be displayed continuously while incoming power is present.

2) FACP shall sound a trouble signal at loss of primary power and to indicate when the system is operating on battery power.

2. Alphanumeric Display and System Controls:

a. Include an LCD display to indicate alarm, supervisory, and component status messages and include a keypad for use in entering and executing control commands.

b. Display battery voltage and amperage readouts on LCD display.

3. System Supervision: Component or power supply failure places system in trouble mode.

4. Group actuating devices together in zones represented by zone light emitting diodes, LED.

a. Provide provisions for supervised zone remote annunciator outputs.

b. Actuation of a UL approved alarm-initiating device shall cause the respective red alarm LED to flash.

1) This LED should continue to flash until the alarms acknowledge switch is actuated.

2) Once acknowledged, the LED or zone LED will be constantly illuminated until the actuating device is restored to normal and the system is reset.

5. FACP shall scan each addressable detector for its type identification to prevent inadvertent substitution of another sensor.

a. Upon detection of a “wrong device,” the FACP shall operate with the installed device at the default alarm settings for that sensor.

6. Supply with an alarm silence/acknowledge switch to silence the audible alarms.

a. Should a subsequent alarm actuation of a different zone occur, the alarm devices shall sound until silenced.

7. Cabinet:

a. UL listed, lockable steel enclosure, red.

b. Front access only.

c. If more than a single unit is required to form a complete control unit, provide matching modular unit enclosures.

B. Software and Software Modifications:

1. Software for Fire Alarm Control Panels:

a. Allows for loading and editing instructions and operating sequences as necessary.

b. Capable of on-site programming to accommodate system expansion and facilitate changes in operation.

c. Stored in a non-volatile programmable memory within the fire alarm control unit.

d. Loss of primary and secondary power shall not erase the instructions stored in memory.

e. Capable of full system operation during a new configuration download.

2. Provide for all software upgrades, modifications, firmware upgrades as required to modify existing Master Fire Alarm Panel to include new Fire Alarm Control Panel nodes.

C. Addressable Manual Pull Stations (Initiating Device):

1. Description:

a. Single action no grip type.

b. Red lexan or metal enclosure.

c. Molded, raised-letter operating instructions of contrasting color.

d. Mechanically latches upon operation and remain so until manually reset by opening with a key common with the fire alarm control panels.

D. Addressable Smoke Detectors (Initiating Device):

1. Shall comply with UL 268.

2. Provide with the following features:

a. Factory Nameplate: Serial number and type identification.

b. Plug-In Arrangement: Detector and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection.

1) Base to provide break-off plastic tab that can be removed to engage the head/base locking mechanism.

2) No special tools required to remove head once it has been locked.

3) Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit.

c. LED that will flash each time it is scanned by the FACP (once every 4 seconds). In alarm condition, the detector head LED shall be on steady.

d. Magnetically actuated test switch to provide for easy alarm testing at the detector location.

e. EMI and RFI shielded.

f. Furnish with a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACP.

1) Detector address to be located in base to eliminate false addressing when replacing detectors.

2) Setting of addresses not required for removal of the detector head for cleaning.

g. Type: Photoelectric smoke. Where acceptable per AHJ, ionization type.

3. Provide end-of-line resistors as required.

E. HVAC Duct Smoke Detectors (Coordinate with HVAC supplier):

1. Addressable Photoelectric type:

a. Powered by HVAC equipment.

b. Furnish with supervised relay driver circuit for driving an auxiliary alarm relay with 2 "Form C" contacts rated at 1A at 28 VDC resistive for interface with local PLC Panel.

1) Auxiliary relay operates when the detector reaches its alarm threshold.

c. Provide a magnetic test area.

d. Red sensor status LED.

2. Duct Housing:

a. Sampling tube design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied.

b. Provide 2 test ports for measuring airflow and for testing.

1) Ports will allow aerosol injection in order to test the activation of the duct smoke detector.

c. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.

3. Remote test station with an alarm LED and test switch.

4. Where indicated or required for outdoor applications, provide a NEMA 4X weatherproof duct housing enclosure.

5. Maintain circulation of conditioned air around the internally mounted duct sensor housing to keep the sensor housing at its rated temperature range.

6. UL Listed to Standard 268A.

7. Addressable duct detectors to provide a trouble signal to the FACP when the detector has reached its limit to compensate for environmental changes.

F. Non-Addressable Smoke Detectors:

1. Photoelectric type:

   a. 120 VAC powered.

   b. Furnish with supervised relay with 2 "Form C" contacts rated at 1A at 28 VDC resistive for interface with local PLC Panel for alarm notification.

G. Addressable Horns/Strobes and Strobe Only (Notification Appliances):

1. Provide power, control, and supervision of horns and strobes over network cable. The network shall digitally communicate with each appliance and receive a response to verify the appliance's presence, health, and status on the channel.

2. Class B (Style 4) notification appliances shall be wired without requiring traditional in/out wiring methods; addressable "T" Tapping shall be used.

3. A visible LED on each appliance provides verification of communications and will flash with the appliances address setting when locally requested using a magnetic test tool.

4. Horn/Strobe:

   a. Listed to UL 1971 and UL 464.

   b. Xenon flash tube.

   c. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe.

   d. Minimum sound pressure level of 83 dBA.

   e. Capable of 2-wire synchronization with one of the following options:

      1) Synchronized strobe with horn on steady.

      2) Synchronized strobe with temporal code pattern on horn.

5. Strobe Only:

   a. Listed to UL 1971.

   b. Xenon flash tube.

   c. Flash intensities of 15 cd, 30 cd, 75 cd, and 110 cd.

   d. Provide a label inside the strobe lens to indicate the listed candela rating of the specific V/O appliance.

H. Wiring:

1. Refer to Section 16123 for Fire Alarm System network wiring and as approved by Fire Alarm System supplier’s designer.

2. Wire and cable shall be as specified and designed by Fire System supplier, meeting the requirements of Section 16123.

3. Wire and cable type shall be listed for its intended use by an approval agency acceptable to the AHJ.

I. Communication Interface Modules:

1. Provide networked fiber optic media transceiver modules to communicate from building's Fire Alarm Control Panel to existing Master Fire Alarm Panel.

2. Provide for expansion modules with fiber media modules at existing Master Fire Alarm Panel. Provide separate panel as required. Fiber optic modems may also be used.

3. Fire Alarm System Supplier's design shall account for fiber communication and include all necessary connectors, power supplies, housing and terminations, for a complete and operable system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Section 16050.

B. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

1. Smoke detectors shall not be installed until after construction cleanup on all trades is complete and final per NFPA 72.

2. Locate FACP as indicated on the Drawings or as approved by ENGINEER.

3. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

4. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor

5. Manual Fire-Alarm Boxes:

a. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.

b. Mount manual fire-alarm box on a background of a contrasting color.

c. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

C. Notification appliances and Initiating devices shall be located by Fire System supplier's design.

D. Wiring:

1. System Wiring:

a. Installed in accordance with the appropriate articles from NFPA 70: National Electric Code (NEC).

2. Color Coding:

a. Paint fire alarm system conduits, junction boxes, and covers red.

b. Circuit that provides power to the FACP shall have a red marking and be identified as “FIRE ALARM CIRCUIT” per NFPA 72.

E. Install framed instructions in a location visible from fire-alarm control unit.

F. Conduits: All wiring shall be installed in GRS.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 16050 and Section 01750.

B. Manufacturer's Field Services: Provide services of a factory-authorized service representative to:

1. Supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

2. Verify proper installation, correct deficiencies, and be present at the jobsite during final inspection by the ENGINEER.

3. Inspection shall be based on completed record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter.

4. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

5. Prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

6. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

C. Field Tests as part of General Start-Up and Testing Procedures:

1. Notify the ENGINEER and the AHJ in writing a minimum of 2 weeks before the scheduled day for the field acceptance tests.

2. Furnish the services of a field service engineer, and any special tools, equipment and labor to perform the tests.

3. Each device and control function shall be individually witness tested and recorded:

a. All acceptance tests shall be witnessed by and signed off by the ENGINEER, the Fire Alarm supplier’s field engineer, the installing Subcontractor, and a representative of the AHJ.

b. Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72

c. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

d. Test audible appliances for the private operating mode according to manufacturer's written instructions.

e. Test visible appliances for the public operating mode according to manufacturer's written instructions.

4. The approved Field Acceptance Test Binder shall form the basis of the documentation of the acceptance tests:

a. Furnish two (2) each certified copies of the tests.

3.03 CLEANING

A. Refer to Section 16050.

3.04 DEMONSTRATION AND TRAINING

A. Refer to Section 16050 and Section 01750.

B. Training:

1. Provide instruction of the OWNER's operation and maintenance staff on the operation and maintenance of the fire alarm system.

2. Separate classes are required for the operations staff and maintenance staff:

a. Operations staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Operations training time is 4 hours (2 classes of 2 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all operators have the opportunity to attend.

b. Maintenance staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Maintenance training time is 4 hours (2 classes of 2 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all maintenance staff has the opportunity to attend.

c. Instruction shall occur at the OWNER's facility and shall utilize the actual fire alarm systems installed at the site.

C. Refer to Section 01750 for further training requirements.

END OF SECTION

SECTION 16752

ELECTRONIC ACCESS CONTROL AND INTRUSION DETECTION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Integrated Access Control and Intrusion Detection system including all design, conduits, cables, hardware, software, programming, testing, startup, and training for a complete and operable security system. Integrate into City's standard security system comprised of Hirsch hardware and software.

2. Provide Hirsch DIGI*TRAC 8N2 Controllers.

3. Provide design, stanchions, conduit, cables and components at the northeast access gate. Coordinate with gate operator supplier for ability to remotely open gate, monitor gate closed position, and interface with Fire Department key switch.

4. Provide water tank hatch intrusion switch.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. As specified in Section 16050.

1.03 DEFINITIONS

A. As specified in Section 16050.

1.04 SYSTEM DESCRIPTION

A. System intent, electronic security component:

1. It is the intent of this Project to provide a fully integrated security system comprised of new security panels with existing security system. There shall

be capability to operate or administrate this system from an existing workstation. The electronic security component generally consists of the following elements: site access control, building access control and building intrusion.

2. The Access Control System (ACS) will act as the overall Security Management System (SMS). It is therefore critical that the system be capable of certain functions:

   a. The ability to integrate at a controller level via software with other components of the security system. This means that the ACS must accept serial data at the access primary network controller level from the other systems, as well as being able to provide instructions via serial interface at the access primary network controller level.

   b. Connection between the primary network controllers must be over Ethernet network via the plant's Control Network.

   c. The ACS must be capable of operating independently of the existing servers and/or existing workstations. That is, loss of a server or workstation will not in any way degrade the functionality of the system. All interfaces between the systems must be performed at the access primary network controller level. Alarms will be hardwired to local PLC Panels tied into the plant's SCADA system.

   d. All access control components will have the ability to be addressed and managed by the head end located elsewhere. All components must have the full functionality provided by that head end system.

B. System functionality:

1. Functionally, the system will operate as follows:

   a. Access control alarms:

      1) The ACS component will operate in such a fashion that any access event or alarm will be noted by the monitoring personnel.

      2) The specific building's ACS will provide hardwired alarm status to the local PLC Panel upon:

         a) Any building door's intrusion switch is open. Two doors are not tied into the ACS; see Contract Drawings.

         b) Any plant site access gate is open.

         c) Building's ACS panel in trouble.

      3) The building's ACS will provide Ethernet communication to the local PLC Panel Control Network via Cat 6 cable.

   b. Building intrusion switches and access hardware:

      1) Every building door and roll up door shall have an intrusion switch. . Two doors are not tied into the ACS; see Contract Drawings. These switches shall be tied back to the building's ACS Hirsch panel. The ACS is intended to take all

those alarms and note and respond to those alarms as required, including a contact output to the local PLC Panel for door intrusion notification.

2) Every building door shall include a junction box that connects the above mention door intrusion switch as well as conduits for electronic door lock (to door frame), conduits for request to exit devices, and conduits down wall to box for exterior mounted Hirsch Card Readers. The junction box shall include conduit and cable back to Hirsch Panel and conduit only to 24 VDC power supply enclosure for door locks. Conduit to Hirsch Panel from junction box shall be sized to accommodate wiring to Hirsch Card Readers, request to exit and electronic door lock control.

3) ACS is intended to communicate with the Hirsch Card Reader, request to exit, and respond by allowing access to electronic door locks. Automatic door locks (striker) will require additional battery backed 24 VDC power supply in addition to Hirsch panel battery system, so design shall consider location and reserve space. Size the 24 VDC power supply for 125% of automatic door locks required of building. Install conduit only for door lock power as part of this work.

4) It is intended that the ACS will be capable of arming and disarming zones with either a valid card swipe. The system will be capable of arming and disarming on time of day and day of week schedule. ACS shall be provided with module space for card reader/keypad units, request to exit devices and door locks.

c. Site Access Gates:

1) Gates at the site are intended to require card reader to enter. Entrance to gates will also be hardwired control from the security panels based on hardwired digital signals from the PLC Panel. Set time zone between 5 pm and 5 am for exiting with exit reader/keypad.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 16050.

B. Product data:

1. Model numbers of all components furnished on the job.
2. Manufacturer's catalog data sheets for all components.
3. Input power requirements for all components.
4. Warranty information.

C. Shop drawings:

1. Complete engineered drawings indicating:

a. Layout, mounting heights, mounting details, and dimensions.

b. Conduit layout for all buildings showing conduit requirements.

c. Point-to-point wiring diagrams for all devices. Include wire specifications.

d. Termination and installation details for all devices.

e. Single-line system architecture drawings representing the entire system.

D. Installation instructions:

1. Manufacturer's installation instructions.

E. Testing and Results

1. Field Acceptance Test procedures and forms as part of General Start-Up and Testing Procedures per Section 01750.

2. Field Acceptance Test results.

3. Certified statement of readiness for the Access Control Systems.

F. Operating and Maintenance Manuals, and as specified in 01780:

1. Complete documentation shall be provided with the system.

2. Drawings shall be in both in AutoCAD and PDF format.

3. The documentation shall completely describe all operations, each program, data sets, and the hardware and peripherals.

a. All updates, addendum, and adjustments to the documentation shall be provided at no additional charge, in the same quantities as originally required.

b. System Administrator Manual:

1) Overview and step-by-step guide and instructions detailing all system administrator responsibility and authority.

c. User Manual:

1) Step by step guide and instructions detailing all system user functions and responsibilities.

4. Alarm Monitoring Manual:

a. Step-by-step guide and instructions detailing all alarm monitoring system user functions and responsibilities.

5. Technical Maintenance Manual:

a. Shall be a comprehensive and detailed document providing all maintenance action, system testing schedules, troubleshooting flowcharts, functional system layout, and block diagrams and schematic diagrams of all system wiring.

1.06 QUALITY ASSURANCE

A. Refer to Section 16050.

B. Provide the services of a security system integrator with the qualifications outlined in ACS Supplier/Installer Qualifications below to coordinate all the work of the ACS suppliers and installers.

C. ACS supplier/installer qualifications:

1. Company specializing in the integration of access control systems and design and installation of cabling infrastructures with a minimum of 5 years documented experience in successful completion of a minimum of 3 projects similar in scope and cost.

2. Minimum of 2 factory-trained and certified technicians on staff for the duration of the Project and the warranty period.

3. Certified Hirsch system designer and installer.

D. Permits and inspections:

1. Material and workmanship will conform to all applicable legal and code requirements, and as specified in the Contract Documents.

2. Perform all tests required to demonstrate conformance with the Contract Documents.

E. Job conditions:

1. The installation is to be supervised on a regular basis by a person designated by the CONTRACTOR. This person will be authorized and will be competent to be in charge of the Project.

1.07 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. Refer to Section 16050.

1.09 WARRANTY

A. Refer to Section 16050.

1.10 SYSTEM STARTUP

A. Refer to Section 16050 and Section 01750.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Access Control System shall be Hirsch Indentive, no equal, to match existing.

2.02 EQUIPMENT

A. Controller:

1. The ACS controllers shall be Hirsch DIGI*TRAC Model 8N2-8 Door to match Owner Standard.

2. Provide with Ethernet communication to local PLC Panel for future tie.

3. Provide with dry contacts to local PLC panel per P&ID drawings.

4. If ACS controllers are networked, provide communication network wiring and conduits as required.

B. Card Reader:

1. Card readers shall be Hirsch HID Prox Point Reader model MR20LA to match Owner Standard.

2. Provide all mounting hardware and stanchions and applicable.

3. See Contract Drawings for location of card readers.

C. Door Switches:

1. Provide Hirsch alarm line modules Hirsch MELM2 at each door (except for Restroom and Storage Room) in junction box to match owner Standard.

2. Provide magnetic door switch, Sentrol or equal.

3. Provide design with door switches on all doors, including roll up doors. Door switches to include stainless steel corrugated wiring protection and stainless steel switches.

4. Restroom and Storage rooms shall be monitored directly by the PLC system.

D. Gate Access Stanchions and Equipment:

1. Provide stanchions per Contract Drawings.

2. Provide Fire Department Key Override Knox Box, Door King 1401, or equal mounted on stanchion.

3. Provide industrial autodial Telephone Intercom with NEMA 3R enclosure with telephone line suppressor, GIA-TRONICS 227-001 to match owner Standard.

4. Provide Hirsch Card Readers as noted within this Section with options for outdoor installation.

2.03 COMPONENTS

A. Wiring:

1. Wiring shall be specified as part of ACS design by system supplier.

2. Provide conduits and wiring as required per ACS design.

2.04 SOURCE QUALITY CONTROL

A. Refer to Section 16050.

2.05 TANK HATCH

A. Component:

1. Tank hatch intrusion switch shall be pre-wired factory sealed cable of 5 feet for wet applications. Roller level switch shall have 316 stainless steel roller with 1.19” to 3” radius adjustable lever arm.

2. Switch shall be provided with two circuits with clockwise or counter clockwise lever movement operation.

B. Manufactured by:

1. Allen-Bradley Model 802M with 802MC-W2B lever

2. Approved equal:

PART 3 - EXECUTION

3.01 PREPARATION

A. Perform a layout check to ensure that adequate access is available for construction, installation, and maintenance of equipment and devices furnished; however, the CONTRACTOR is not responsible for furniture. The CONTRACTOR shall consult the OWNER and ENGINEER in the design of the monitoring workstation area.

3.02 INSTALLATION

A. Although expected locations are indicated on the Drawings, all equipment locations, including controllers, card readers/keypads and all alarm devices shall be field verified with the ENGINEER

B. All entry doors into the building shall include junction box and conduits installed for keypad, electronic door latch, request to exit, and door intrusion switch per manufacturer's recommendation. ACS design shall account for all conduits from junction box to keypad, electronic door latch, request to exit, and door intrusion switches. Conduits from junction box back to controller and power supply enclosure shall provide capacity for keypad, request to exit, and electronic door latch control and power wiring.

C. Installation of the ACS shall include the appropriate equipment and shall be performed by a factory-trained and certified contractor. The installation shall be completed to these Specifications and Project Drawings as required by the OWNER or prime contractors. The installation shall include the following:

1. Site planning and system configuration of field hardware and ACS and interface into existing system. The CONTRACTOR shall consult with the OWNER and ENGINEER for final required access level configuration, and other systems programming.

2. Complete system modifications at the head end.

3. Complete system diagnostics verification.

4. Complete system operation verification.

5. Problem reporting and tracking.

6. Project specific installation log.

7. Completion of specific field acceptance test plans per Section 01750.

8. Formal turnover of the specific project installation documentation to the OWNER.

3.03 FIELD QUALITY CONTROL

A. Perform acceptance tests to show system is properly installed and that it meets the Specifications and applicable codes. Refer to Section 01750.

B. All equipment to be installed per applicable UL listing for that device or component.

C. Comply with manufacturer's instructions and recommendations for installation of product in the applications indicated. Anchor products securely in place, accurately located and aligned with other work.

D. Field Acceptance Testing:

1. All Field Acceptance Testing shall be witnessed by and signed off by the ENGINEER and the system designer.

2. The CONTRACTOR shall furnish any special tools, equipment, and labor to perform the tests.

3. The ENGINEER shall be notified in writing a minimum of two weeks prior to the scheduled day for the Access Control System tests.

4. Field Acceptance Testing is part of General Start-Up and Testing Procedures per Section 01750.

3.04 CLEANING

A. Refer to Section 16050.

3.05 DEMONSTRATION AND TRAINING

A. Provide system training on-site by a representative of the ACS manufacturer. Training shall take place after the system is operational yet before substantial completion. A detailed description of the training material shall be included in the submittal package.

1. Training shall explain the system functions and operations. Training course shall offer configuration training on all aspects of the system including data import-export, reports, cardholder management, peripherals, and field hardware.

B. All levels of training must provide a syllabus as well as the names and qualifications of each person providing the training. These submittals must be approved by the ENGINEER prior to training beginning.

C. Training:

1. Provide instruction of the OWNER’s operation and maintenance staff on the operation and maintenance of the security system.

2. Separate classes are required for the operations staff and maintenance staff:

a. Operations staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Operations training time is 4 hours (2 classes of 2 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all operators have the opportunity to attend.

b. Maintenance staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 4 hours. Total Maintenance training time is 8 hours (2 classes of 4 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all maintenance staff has the opportunity to attend.

c. Instruction shall occur at the OWNER's facility and shall utilize the actual security systems installed at the site.

D. Refer to Section 01750 for further training requirements.

3.06 PROTECTION

A. Refer to Section 16050.

END OF SECTION

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SECTION 16922

TELEMETRY SYSTEM

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Radio/modem/antenna, antenna mast, and accessories.

2. Telemetry System supplied shall be complete system including: design, layout, supply, installation, testing, startup, and training. Provide all necessary equipment and hardware for a complete and operable Telemetry System. Not all equipment is shown on Drawings.

3. The Drawings and Specifications are not intended to be a complete listing of all components required for the system. All auxiliary and accessory equipment necessary for system performance in compliance with the applicable codes shall be provided even if not specifically detailed on the drawings or in these specifications. Preparation, design and submittal of detailed, project-specific installation drawings (including but not necessarily limited to mounting, interconnection, wiring type details, supportive calculations, etc.) shall be included as a part of this work.

4. CONTRACTOR shall coordinate location of equipment and mounting heights as not to interfere with other equipment, piping, etc. ENGINEER to approve final equipment positions and mounting heights as determined by the CONTRACTOR based on equipment supplied and installation and routing of materials.

5. CONTRACTOR is responsible for submitting for approval professional Engineer stamped and signed anchoring calculations and anchoring plate designs for antenna masts.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 16050 - Common Work Results for Electrical.

1.02 REFERENCES

A. As specified in Section 16050.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. The equipment covered under this contract shall be designed, manufactured, and tested in accordance with the latest version of the following industrial standards:

1. American National Standards Institute (ANSI)/Institute of Electrical and Electronic Engineers (IEEE):

a. C37.90.2, Trial-Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.

b. C62.41, IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

2. Electronic Industries Association (EIA):

a. TIA-232-E, Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange.

b. 422-A, Electrical Characteristics of Balanced Voltage Digital Interface Circuits.

3. National Electrical Manufacturers Association (NEMA):

a. ICS 1, General Standards for Industrial Control and Systems.

b. ICS 1.1, Safety Guidelines for the Application, Installation and Maintenance of Solid State Control.

c. ICS 4, Terminal Blocks for Industrial Use.

d. ICS 6, Enclosures for Industrial Controls and Systems.

4. National Fire Protection Association (NFPA):

a. National Electric Code (NEC).

1.04 SYSTEM DESCRIPTION

A. Provide radio, modem, antenna, power supplies and accessories for all telemetry system, complete and operable, in accordance with the requirements of the Contract Documents.

B. Provide additional system (matching that provided at Shasta PS) to be located at Meadowview. Two radios systems shall be provided: one at Shasta PS and one at remote location to be verified by Contractor.

C. Provide field radio site survey between Shasta PS and preferred monitoring location. If link fails, installed at alternate location at no additional charge to Owner. Monitoring location in descending order of preference:

1. Meadowview

2. CWTP

3. Brighton Heights

4. Florin Reservoir

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050.

B. Submit a complete material list of major products, with name of manufacturer, trade name, model number, and part number for each proposed product. List the quantity of each proposed product to be supplied. In addition, list the type, size, color, etc., necessary to identify the proposed product.

C. Descriptive literature shall be provided that describes the radio system and all accessories. This literature shall provide sufficient detail to determine that the telemetry system has all the accessories, options, and features specified herein.

D. Submit product data sheets and catalog cuts for:

1. Radio.

2. Diagnostic software.

3. Antenna, mounting and support.

4. 50 foot Antenna tower, mounting and support.

5. Coax cable.

6. Lighting arrestor.

7. Power Supply.

8. Manufacturer's installation instructions and mounting details

E. Submit interface electrical/electronic schematics and wiring diagrams for:

1. Radio to Modem/surge arrestor.

2. Modem to power supply.

3. Radio to RS-232 /422 converter unit.

F. Shop drawings:

1. Telemetry system block diagram.

2. Schematic of systems.

3. Wiring and conduit layout drawings.

4. Conduit and cable schedules.

G. Calculations:

1. Provide complete design calculations and installation documents for antenna masts:

a. Include in the calculations the wind and seismic requirements at the project sites.

b. Calculations and design shall be performed by and signed by a structural Professional Engineer registered in California:

1) Because this design is being provided by a Professional Engineer, the submittal will be reviewed for form and content but not reviewed for technical completeness, methods, or calculations.

2) Calculations may be provided by manufacture, but still require Professional Structural Engineer stamp and signature.

c. Design shall include the base plate and anchor bolts. Tower shall met the deflection criteria required by the antenna manufacturer.

H. Field Testing and Results as part of General Start-Up and Testing Procedures:

1. Field Acceptance Test procedures and forms.

2. Field Acceptance Test results.

3. Certified statement of readiness for the Telemetry System.

I. Record documents:

1. Provide as-built drawings in AutoCAD and PDF formats for telemetry system.

2. Operating and Maintenance Manuals as specified in 01780. Telemetry O&M manuals shall be provided in separate binders.

3. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration.

J. Warranties

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. Manufacturer's service personnel shall perform all tests, inspections, and adjustments required by the manufacturer and as specified in this section. Manufacturer's service personnel shall report to the job-site with any test equipment and special tools as required and specified.

C. Provide as many site visits as are required to ensure proper Telemetry System installation, configuration and operation. The field service personnel shall perform the following:

1. Pre-installation:

a. Familiarize the electrical contractor with the wiring and mounting requirements for all devices in the Telemetry System prior to any equipment or wiring/conduit infrastructure installation.

b. Review the electrical contractor's proposed conduit and wiring layouts and equipment locations, and schedules. Coordinate any necessary changes as required through the Engineer.

2. Start up and Operation:

a. Verify proper connection of power feeders and wiring.

b. Verify proper connection of network connected devices.

c. Energize the telemetry system and coordinate with City for radio configuration.

d. Adjust antenna and radio as required.

e. Verify telemetry system operation. Make adjustments to configuration as required by OWNER and ENGINEER.

f. Verify proper operation of the Ethernet TCP/IP interface to Remote Network.

3. Post Installation Adjustment and Training:

a. Fine tune the system and address punch list items after an initial period of use. This shall be performed prior to completion of General Start-Up and Testing Procedures phase. Refer to Section 01750.

D. Statement of readiness: following completion of the field inspections, adjustments, and tests, the manufacturer's service personnel shall submit a signed statement to the Engineer stating that the antenna system has been properly installed, adjusted, and tested, and is ready for energization.

E. Equipment shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 16050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.09 SCHEDULING

A. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

1.10 WARRANTY

A. As specified in Section 16050.

B. The Supplier shall furnish to the Owner a listing of warranty information for all manufacturers of materials and equipment supplied under the scope of work covered in this Section. The listing shall include the following:

1. Manufacturer's name, service contact person, phone number, and address.

2. Material and equipment description, equipment number, part number, serial number, and model number.

3. Warranty expiration date.

C. The following services shall be provided during the warranty period:

1. The Supplier shall warrant all equipment for a period of one (1) year from date of final acceptance. Standard published warranties of equipment which exceed the preceding specified length of time shall be honored by the manufacturer.

2. The Supplier shall provide all material to replace or repair any hardware that fails during the warranty period, at no additional cost to Owner.

3. Free technical phone support on equipment for a period of one year shall be provided. Support shall be provided directly from the manufacturer. Phone support shall be available between 8 a.m. and 5 p.m. Monday through Friday.

1.11 SYSTEM START UP

A. As specified in Section 16050 and Section 01750.

1.12 SPARE PARTS

A. Provide list of spare parts recommended by radio manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. General:

1. It is the intent of these design documents to secure a telemetry system of the latest industrial design that has been prototype tested, factory built, production tested, site tested, as a total unit together with all accessories.

2. All materials, components, and parts supplied shall be highest grade, unused, new, and in current production.

3. Provide all of the features, options, and accessories specified herein and shown on the design Drawings.

4. In addition to the requirements of these technical specifications, all equipment supplied shall meet all of the manufacturer's specifications listed for said equipment, which are in effect at the time of bid submission.

5. Interchangeability - All parts having the same manufacturer's part number shall be functionally and dimensionally interchangeable.

2.02 EQUIPMENT

A. Radio/Modems/Antenna:

1. Provide DragonWave Horizon Quantum systems to match City Standard. The following DragonWave equipment shall be provided at each site:

a. 50 Mbps Horizon Quantum System, 18 GHz Band 1,Dual Channel, Single Radio;48V DC

b. Horizon Quantum Upgrade 10 Mbps to 800 Mbps (Per Link - Requires Dual-Modem Configuration)

c. Link Upgrade, Horizon Quantum Feature, Bundle (AAM, XPIC , MSTP/RSTP and Advanced Ethernet)

d. 3' / 90cm, 18 GHz Antenna, Clip-Mount

e. Horizon Quantum, Single Radio AC Install Kit (N. America)

f. Horizon Quantum Cable: 30m LMR-400 Cable

g. 18 GHz Dual Pole Rigid Mount (DPRM)

h. 3 Year Horizon Quantum Global Advanced replacement (Next Business Day) - Incl. Warranty

2. Speed shall be 1GBPS or higher.

B. Lightning Arrestor:

1. Provide lightning arrestors per DragonWave' recommendation for installed radio/modem.

C. Transmission Cables:

1. Supply the transmission cables to connect each radio antenna port (via 50 ohm "Superflex" cable/lightning arrester) with the existing antennas. The cables shall be low-loss foam-dielectric type, 1/2 inch in diameter, and sufficient length to route each cable from the existing antennas to each lightning arrester (field verify). The transmission cables shall be weatherproof suitable for direct environmental exposure. Use "O" ring seals on all connectors. The transmission cables shall be Andrew Corp. LDF4-50A. The cables shall be installed without splices.

2. Provide a section of "Superflex" cable between each radio and the lightning arresters. The cables shall be per manufacturer's recommendation.

3. Connectors for the transmission cable shall be type N. Connectors shall be protected from weather by a vapor-wrap application. Provide Type N connectors with weatherproof "O" ring seals, as recommended by the coaxial cable manufacturer

4. Provide connector weatherproofing kits for outdoor exposed connectors and grounding strap attachments. All mating connectors that are exposed to weather shall be wrapped with a sealing material designed to protect against water and dirt entry into the connectors.

5. The Contractor shall field verify the length of antenna cable required for the project. The cables shall be installed without splices.

6. The cable shall be carefully installed to prevent damage to the jacket and routed with a minimum bending radius of 6 inches.

D. The Contractor shall install the lightning protector, copper strap, hanger kits, instrument grounding, etc. The Contractor shall install a copper wire per Contract Drawings to connect the lightening arresters to the ground bus

E. Antenna Tower:

1. Antenna system shall be installed and supported as shown on the Contract Drawings. Support members shall have sufficient strength to withstand local wind conditions and shall be protected from sun exposure and corrosive chemical damage. Antenna tower shall be self-supporting.

2. Support hardware such as clamps, orientation mounts, and offset brackets shall be steel protected with a hot dip galvanized finish or stainless steel. Clamps and mounts shall be heavy duty in order to transfer the full antenna load to the support mast or tower. Bolts and screws shall be stainless steel.

3. Antenna tower shall be provided with sufficient space to accommodate the following future antennas:

   a. One (1) Dragonwave microwave antenna.

   b. One (1) Yagi antenna.

PART 3 - EXECUTION

3.01 PREPARATION

A. Perform a layout check to ensure that adequate access is available for construction, installation, and maintenance of equipment and devices furnished; however, the CONTRACTOR is not responsible for furniture. The CONTRACTOR shall consult the OWNER and ENGINEER in the design of the telemetry system.

3.02 INSTALLATION

A. As specified in Section 17050.

B. All equipment to be installed per applicable UL listing for that device or component.

C. Comply with manufacturer's instructions and recommendations for installation of product in the applications indicated.

D. Anchor products securely in place, accurately located and aligned with other work.

E. Radio installer shall be certified installer of DragonWave radio/antenna.

F. All licensing applications shall be prepared by radio installer.

G. Provide additional three year manufacturer warranty for all components supplied under this specification section.

H. Field Acceptance Testing:

   1. All Field Acceptance Testing shall be witnessed by and signed off by the ENGINEER and the system designer.

   2. The CONTRACTOR shall furnish any special tools, equipment, and labor to perform the tests.

   3. The ENGINEER shall be notified in writing a minimum of two weeks prior to the scheduled day for the Telemetry System tests.

   4. Field Acceptance Testing is part of General Start-Up and Testing Procedures per Section 01750.

   5. Coordinate with the City for the following:

      a. Configure radio communication parameters.

      b. Configure radio output power.

I. Although expected locations are indicated on the Drawings, all equipment locations, including antenna masts and all telemetry devices shall be field verified with the ENGINEER

J. Install antenna masts per the manufacturer’s guidelines and submitted installation calculations to meet seismic and wind requirements at the project site.

3.03 FIELD QUALITY CONTROL

A. As specified in Section 16050.

B. Telemetry System:

1. All Field Acceptance Testing, as part of the General Start-Up and Testing Procedures in Section 01750; shall be witnessed by and signed off by the ENGINEER and the Telemetry System suppliers' designer.

2. The CONTRACTOR shall furnish any special tools, equipment, and labor to perform the tests.

3.04 CLEANING

A. As specified in Section 16050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 16050 and Section 01750.

1. Perform the telemetry system demonstration, in accordance with this Section, witnessed by the OWNER and the ENGINEER. Training shall take place after the system is operational yet before substantial completion. A detailed description of the training material shall be included in the submittal package.

B. All levels of training must provide a syllabus as well as the names and qualifications of each person providing the training. These submittals must be approved by the ENGINEER prior to training beginning.

C. Training:

1. Provide instruction of the OWNER's operation and maintenance staff on the operation, maintenance and troubleshooting of the telemetry system.

2. Separate classes are required for the operations staff and maintenance staff:

a. Operations staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 2 hours. Total Operations training time is 4 hours (2 classes of 2 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all operators have the opportunity to attend.

b. Maintenance staff training shall consist of two identical training sessions, each consisting of 1 session per day, with each session lasting 4 hours. Total Maintenance training time is 8 hours (2 classes of 4 hours each):

1) The sessions shall be scheduled with the OWNER to ensure all maintenance staff has the opportunity to attend.

c. Instruction shall occur at the OWNER's facility and shall utilize the actual telemetry system installed at the site.

D. Refer to Section 01750 for further training requirements.

3.06 PROTECTION

A. As specified in Section 16050.

END OF SECTION

SECTION 16950

FIELD ELECTRICAL ACCEPTANCE TESTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Responsibilities for testing the electrical installation.
2. Routine tests during installation.
3. Adjusting and calibration.
4. Field acceptance tests shall be part of General Start-Up and Testing Procedures as defined in Section 01750.
5. Demonstration of electrical equipment as part of Functional Testing as defined in Section 01750.
6. Commissioning shall be part of Certification of Proper Installation as defined in Section 01750.
7. Plant start-up shall be part of Operational Testing as defined in Section 01750.
8. Training requirements shall be per Section 01750.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01320 - Progress Schedules and Reports.
   b. Section 01330 - Submittal Procedures.
   c. Section 01750 - Testing, Training, and Facility Start-Up.
   d. Section 16050 - Common Work Results for Electrical.
   e. Section 16060 - Grounding and Bonding.
   f. Section 16123 - 600 Volt or Less Wire and Cables.
   g. Section 16125 - Fiber Optic Cable and Appurtenances.
   h. Section 16445 - Panelboards.

i. Section 16500 - Lighting.

j. Section 16710 - Fire Alarm and Smoke Detection System.

k. Section 16752 - Electronic Access Control and Intrusion Detection.

l. Section 17950 – Testing, Calibration and Commissioning.

C. Copyright information:

1. Some portions of this Section are copyrighted by the International Electrical Testing Association, Inc. (NETA). See NETA publication Acceptance Testing Specification for details.

1.02 REFERENCES

A. As specified in Section 16050.

B. Manufacturer's testing recommendations and instruction manuals.

C. Specification sections for the electrical equipment being tested.

D. Shop drawings.

1.03 DEFINITIONS

A. As specified in Section 16050.

B. Specific definitions:

1. NETA Testing Agency: The third party organization performing electrical equipment Field Acceptance Testing based on NETA Acceptance Testing Specification and these contract documents.

1.04 SYSTEM DESCRIPTION

A. Testing of all electrical equipment installed under this Contract in accordance with the manufacturer's requirements and as specified in this Section.

B. Conduct all tests in the presence of the ENGINEER or the ENGINEER's representative:

1. The ENGINEER will witness all visual, mechanical and electrical tests and inspections.

C. The testing and inspections shall verify that the equipment is operational within the tolerances required and expected by the manufacturer, and these Specifications. The results of the tests shall determine the suitability for continued reliable operation.

D. All equipment shall be programmed and or configured prior to Field Acceptance Testing. This includes all protective relays, VFDs, RVSSs, adjustable overcurrent devices and power monitoring equipment.

E. Responsibilities:

1. CONTRACTOR responsibilities:

a. Ensure that all resources are made available for testing, and that all testing requirements are met.

2. Electrical subcontractor responsibilities:

   a. Perform routine tests during installation: continuity, megger of low voltage cables, verify rotation, grounding system testing, motor testing, etc.

   b. Labeling all equipment per Section 16075.

   c. Demonstrate operation of electrical equipment.

   d. Commission the electrical installation.

   e. Provide the necessary services during testing, and provide these services to the NETA Testing Agency, CONTRACTOR, and other subcontractors, including but not limited to:

      1) Providing electrical power as required.

      2) Operating of electrical equipment in conjunction with testing of other equipment.

      3) Activating and shutting down electrical circuits.

      4) Making and recording electrical measurements.

      5) Replacing blown fuses.

      6) Installing temporary jumpers.

3. NETA Testing Agency responsibilities:

   a. Verify all protective relays have been programmed.

   b. Verify all overcurrent devices have correct settings.

   c. Verify all networked equipment is communicating.

   d. Perform all acceptance tests as defined in these contract documents and per latest edition of NETA Field Acceptance Testing Specifications.

   e. Provide all required equipment, materials, labor, and technical support during acceptance tests.

   f. If equipment fails test immediately notify ENGINEER and CONTRACTOR and provide written document describing equipment and failed results. Provide recommendation for action.

   g. Upon completion of testing or calibration, attach the NETA Testing Agency's company label to all tested equipment and devices:

      1) The label shall indicate the date testing was successfully completed and the initials of Testing Agency representative that performed the test.

   h. Upon successful, completed testing for a building or Area; provide written certification that all electrical equipment has been properly installed, configured, tested and is ready for operation. Certification shall be on Testing Agency letterhead and be signed and stamped by California Professional Electrical Engineer.

4. Designers of Specification Sections 16500, 16710, 16752 responsibilities:

a. Verify installation.

b. Submit Field Acceptance Testing procedures and results.

c. Start up and training on system.

d. Provide all required equipment, materials, labor, and technical support during acceptance tests.

e. If equipment fails test immediately notify ENGINEER and CONTRACTOR and provide written document describing equipment and failed results. Provide recommendation for action.

f. Upon successful, completed testing for a building or Area; provide written certification the system has been properly installed, configured, tested and is ready for operation. Certification shall be on company letterhead and be signed by authorized representative.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 16050 and 17950.

B. Cable testing form:

1. LAN cable test reports:

a. Submit 3 copies of test reports showing the results of all tests specified in this Section:

1) Test type.

2) Test location.

3) Test date.

4) Cable number.

5) Cable length.

6) Certification that the cable meets or exceeds the specified standard.

b. Furnish hard copy and electronic copy for all traces.

c. LAN cables include all networked type communication cables: Cat 6 cables, RS-485 cables, etc.

2. Fiber cable testing requirements: per Section 16125.

C. Test Reports:

1. Include the following:

a. Summary of Project.

b. Description of equipment tested.

c. Description of tests performed.

d. Test results.

e. Conclusions and recommendations.

f. Completed test forms.

g. List of test equipment used and calibration dates.

h. Cable test reports.

2. Test Reports shall be included in separate binders with labeling on front cover and spine by individual Specification Section.

D. Testing of electrical equipment specified in Sections 16050 thru 16494, with exception of Sections 16123 and 16125; shall be done by NETA certified testing agency.

1. NETA Testing Agency qualifications:

a. Submit NETA Testing Agency

b. Submit a complete statement of qualifications from the proposed NETA Testing Agency detailing experiences in performing the tests specified:

1) This statement will be used to determine whether the laboratory is acceptable, and shall include:

a) Corporate history and references.

b) Resumes of individuals performing test.

c) Equipment list and test calibration data.

2. Submit testing procedures by Specification Section based on individual Specification Section, this Section and the latest NETA requirements.

3. Submit successful Field Acceptance Testing results with tester and witness signatures.

4. If equipment fails; submit written document describing equipment and failed results. Provide recommendation for action.

5. Submit written certification that all electrical equipment has been properly installed, configured, tested and is ready for operation. Certification shall be on Testing Agency letterhead and be signed and stamped by California Professional Electrical Engineer.

E. Testing of wires and cables installed per Section 16123 may be tested by electrical subcontractor or NETA Testing Agency.

1. Submit a list identifying who is responsible for performing each portion of the testing.

2. Submit testing procedures, megger forms, continuity forms and Cat 6 testing forms.

3. Submit successful Field Acceptance Testing results with tester and witness signatures.

4. If equipment fails; submit written document describing equipment and failed results. Provide recommendation for action.

F. Testing of fiber optic cable installed per Section 16125 may be tested by installing fiber subcontractor.

1. Submit a list identifying who is responsible for performing each portion of the testing.
2. Submit testing procedures and forms.
3. Submit successful Field Acceptance Testing results with tester and witness signatures.
4. If equipment fails; submit written document describing equipment and failed results. Provide recommendation for action.
5. Submit written certification that all electrical equipment has been properly installed, configured, tested and is ready for operation. Certification shall be on testing company letterhead and be signed by authorized representative.

G. Testing of equipment specified in Sections 16500 thru 16870 shall be equipment system responsible designer and installer.

1. Submit a list identifying who is responsible for performing each portion of the testing.
2. Submit manufacturers' recommended testing procedures for review by the ENGINEER per Specification Section.
3. Submit successful Field Acceptance Testing results with tester and witness signatures.
4. If equipment fails; submit written document describing equipment and failed results. Provide recommendation for action.
5. Submit written certification that all electrical equipment has been properly installed, configured, tested and is ready for operation. Certification shall be on testing company letterhead and be signed by authorized representative.

1.06 QUALITY ASSURANCE

A. As specified in Section 16050.

B. All Field Acceptance Testing shall be witnessed and signed off by ENGINEER to be considered complete as part of General Start-Up and Testing Procedures phase per Section 01750.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 16050.

1.08 SEQUENCING

A. Perform field testing in the following sequence as part of the General Start-Up and Testing Procedures:

1. Cable megger tests.
2. Cable hipot tests.
3. Grounding resistance and continuity tests.
4. Electrical Field Acceptance Tests per Section 16950.

5. Visual check installation.
6. Visual check nameplates, conduit and cable labels, arc-flash labels.
7. Verify communication networks.
8. Provide instrument calibration.
9. Verify initial setpoints and trips on instruments.
10. Verify initial ranges on instruments.
11. Check interlocks, control circuits, alarms, and all measured parameters and settings.
12. Verify settings of overcurrent protection devices and protective relays.
13. Test switchgear, switchboards, panelboards and transformers for proper operation.
14. Motor rotation and measure full load ampacity.
15. Verify operation of Kirk Key interlocks.
16. Others and order per approved CONTRACTOR'S Start-Up Plan as required in Section 01750.

B. Perform work as required for Functional Testing as defined in Section 01750.

C. Obtain Certification of Proper Installation from manufacturers as required in Section 01750.

D. Perform Training of Owner's Personnel as required in specific specification sections and defined in Section 01750.

E. Perform work as required for Operational Testing as defined in Section 01750.

1.09 WARRANTY

A. As specified in Section 16050.

1.10 COMMISSIONING

A. Plant Start-Up shall not begin until electrical Field Acceptance Testing as part of General Start-Up and Testing Procedures, Functional Testing, Certification of Proper Installation, Training and Operational Testing is complete to the satisfaction of the ENGINEER.

B. Plant Start-Up shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable:

1. Simulation of process parameters will be considered only upon receipt of a written request by the CONTRACTOR.

C. Record all motor currents during normal operation during Plant Start-Up phase, minimum two readings over two hours run time.

D. Record the indications of all power meters every half-hour during Plant Start-Up for two hours.

PART 2 - PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. NETA Testing Agency shall be Apparatus Testing and Engineering Inc. (Mr. Lee Madsen 916-715-5906), or equal.

B. General:

1. Electrical Testing instrument calibration:

a. Utilize a NETA Testing Agency with a calibration program which maintains all applicable test instrumentation within rated accuracy.

b. The accuracy shall be traceable to the National Institute of Standards and Technology (NIST) in an unbroken chain.

c. Calibrate instruments in accordance with the following frequency schedule:

1) Field instruments: 6 months maximum.

2) Laboratory instruments: 12 months maximum.

3) Leased specialty equipment where the accuracy is guaranteed by the lessor (such as Doble): 12 months maximum.

d. Dated calibration labels shall be visible on all test equipment.

e. Maintain an up-to-date instrument calibration record for each test instrument:

1) The records shall show the date and results of each calibration or test.

f. Maintain an up-to-date instrument calibration instruction and procedure for each test instrument.

PART 3 - EXECUTION

3.01 PREPARATION

A. Do not begin testing until the following conditions have been met:

1. All instruments required are available and in proper operating condition.

2. All required dispensable materials such as solvents, rags, and brushes are available.

3. All equipment handling devices such as cranes, vehicles, chain falls and other lifting equipment are available or scheduled.

4. All instruction books, calibration curves, or other printed material to cover the electrical devices are available.

5. Data sheets to record all test results are available and approved.

6. All cables and conduits are labeled.

7. All equipment has approved nameplates.

8. All equipment suppliers have approved installation where required.

3.02 FIELD QUALITY CONTROL AND FIELD ACCEPTANCE TESTING

A. Field Quality Control and Field Acceptance Testing are part of General Start-Up and Testing Procedures per Section 01750.

B. Switchgear and Switchboard:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding and required area clearances.

d. Inspect equipment for cleanliness.

e. Verify that circuit breaker/fuse sizes and types correspond to the approved submittals and the coordination study.

f. Verify that current and voltage transformer ratios correspond to that indicated on the Drawings.

g. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

h. Mechanical and electrical interlocks:

1) Attempt closure on locked-open devices.

2) Attempt to open locked-closed devices.

3) Make/attempt key-exchanges in all positions.

4) Attempt to parallel two or more sources in all switchgear operating modes.

i. Lubrication requirements:

1) Verify appropriate lubrication on moving current-carrying parts.

2) Verify appropriate lubrication on moving and sliding surfaces.

j. Inspect insulators for evidence of physical damage or contaminated surfaces.

k. Verify correct barrier and shutter installation and operation.

l. Exercise all active components.

m. Inspect all indicating devices for correct operation.

n. Verify that filters are in place and/or vents are clear.

o. Perform visual and mechanical inspection of instrument transformers as specified in this Section.

p. Inspect control power transformers:

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

2) Verify that primary and secondary fuse/circuit breaker ratings match the submittal drawings.

3) Verify correct functioning of drawout disconnecting and grounding contacts and interlocks.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter if applicable.

b. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for 1 minute.

1) Perform test in accordance with NETA ATS tables.

c. Perform a dielectric withstand voltage test on each bus section, each phase to ground with phases not under test grounded, in accordance with manufacturer's published data or NETA ATS tables. Apply the test voltage for 1 minute.

d. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

e. Perform electrical tests on instrument transformers as specified in this Section.

f. Perform ground-resistance tests:

1) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral and derived neutral points.

g. Determine the accuracy of all meters.

h. Control power transformers:

1) Perform insulation resistance tests. Perform measurements from winding-to-winding and each winding-to-ground:

a) Test voltages shall be in accordance with NETA ATS tables or as specified by the manufacturer.

2) Perform secondary wiring integrity test:

a) Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source:

(1) Verify correct potential at all devices.

3) Verify correct secondary voltage by energizing primary winding with system voltage:

a) Measure secondary voltage with the secondary wiring disconnected.

i. Voltage transformers:

1) Perform secondary wiring integrity test:

a) Verify correct potential at all devices.

2) Verify correct secondary voltage by energizing primary winding with system voltage.

j. Perform current injection tests on the entire current circuit of each switchgear or switchboard:

1) Perform current tests by secondary injection with magnitudes such that a minimum current of 1.0 ampere flows in the secondary circuit:

a) Verify the correct magnitude of current at each device in the circuit.

k. Perform system function tests.

l. Verify operation of space heaters.

m. Perform phasing check on double-ended or dual-source equipment to ensure correct bus phasing from each source.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Compare bus connection resistances to values of similar connections.

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values of bus insulation shall be in accordance with manufacturer's published data:

a) Refer to NETA ATS tables in the absence of manufacturer's published data.

b) Investigate insulation values less than the allowable minimum.

c) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.

e. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

f. Insulation-resistance values for control wiring shall not be less than 2 megohms.

g. Instrument transformer test values as specified in this Section.

h. Investigate grounding system resistance values that exceed 0.5 ohm.

i. Meter accuracy shall be in accordance with manufacturer's published data.

j. Control power transformers:

1) Insulation resistance values of control power transformers shall be in accordance with manufacturer's published data:

a) Refer to NETA ATS tables in the absence of manufacturer's published data.

b) Investigate insulation values less than the allowable minimum.

c) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.

2) Secondary wiring shall be as indicated on the Drawings and specified in the Specifications.

3) Secondary voltage shall be as indicated on the Drawings.

4) Control transfer relays shall perform as designed.

k. Voltage transformers:

1) Secondary wiring shall be as indicated on the Drawings and specified in the Specifications.

2) Secondary voltage shall be as indicated on the Drawings.

l. Current-injection tests shall prove current wiring is as indicated on the Drawings and specified in the Specifications.

m. Results of system function tests shall match the Drawings and Specifications.

n. Heaters shall be operational.

o. Phasing checks shall prove the switchgear or switchboard phasing is correct and as indicated on the Drawings and specified in the Specifications.

C. Dry type transformers:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify that resilient mounts are free and that any shipping brackets have been removed.

e. Inspect equipment for cleanliness.

f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

g. Verify that as-left tap connections are as specified.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground:

1) Apply voltage in accordance with manufacturer's published data.

a) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Calculate dielectric absorption ration or polarization index.

d. Perform turns ratio tests at all tap positions.

e. Verify correct secondary voltage, phase-to-phase and phase-to-neutral after energization and before loading.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Tap connections are left as found unless otherwise specified.

e. Minimum insulation resistance values of transformer insulation shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate insulation values less than the allowable minimum.

f. The dielectric absorption ratio or polarization index shall not be less than 1.0.

g. Turns-ratio results should not deviate more than 1/2 percent from either the adjacent coils or calculated ratio.

h. Phase-to-phase and phase-to-neutral secondary voltages shall be in agreement with nameplate data.

D. Cables, 600 volts and less:

1. Visual and mechanical inspection:

a. Compare cable data with that indicated on the Drawings and specified in the Specifications.

b. Inspect exposed sections of cables for physical damage and correct connection as indicated on the Drawings.

c. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

d. Inspect compression-applied connectors for correct cable match and indentation.

e. Inspect for correct identification and arrangements.

f. Inspect jacket insulation and condition.

2. Electrical tests:

   a. Perform resistance measurements through bolted connections with low-resistance ohmmeter.

   b. Perform insulation-resistance tests on each conductor with respect to ground and adjacent conductors:

      1) Applied voltage shall be:

         a) 500 VDC for 300-volt rated cable.

         b) 1,000 VDC for 600-volt rated cable.

      2) Test duration shall be 1 minute.

   c. Perform continuity tests to ensure correct cable connection.

   d. Verify uniform resistance of parallel conductors.

3. Test values:

   a. Compare bolted connection resistance values to values of similar connections:

      1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

   b. Bolt-torque levels shall be in accordance with manufacturer's published data:

      1) Refer to NETA ATS tables in the absence of manufacturer's published data.

   c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

   d. Insulation resistance values shall be in accordance with manufacturer's published data:

      1) Refer to NETA ATS tables in the absence of manufacturer's published data.

      2) Investigate values of insulation resistance less than the allowable minimum.

   e. Cables shall exhibit continuity.

   f. Investigate deviations in resistance between parallel conductors.

E. Low voltage molded case and insulated case circuit breakers:

1. Visual and mechanical inspection:

$$R_{1000\,ft} = \text{Measured Resistance} \times \frac{\text{Length of run}}{1000}$$

   a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

   b. Inspect physical and mechanical condition.

   c. Inspect anchorage and alignment.

d. Verify the unit is clean.

e. Operate circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance by one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

g. Inspect operating mechanism, contacts, and arc chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed and across each open pole:

1) Apply voltage in accordance with manufacturer's published data.

2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Perform a contact/pole-resistance test.

d. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

e. Determine long-time pickup and delay by primary current injection.

f. Determine short-time pickup and delay by primary current injection.

g. Determine ground-fault pickup and delay by primary current injection.

h. Determine instantaneous pickup value by primary current injection.

i. Test functions of the trip unit by means of secondary injection.

j. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.

k. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function and trip unit battery condition:

1) Reset all trip logs and indicators.

l. Verify operation of charging mechanism.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate values of insulation resistance less than the allowable minimum.

e. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:

1) If manufacturer's data in not available, investigate any values which deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

f. Insulation resistance values of control wiring shall not be less than 2 megohms.

g. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band including adjustment factors:

1) If manufacturer's curves and are not available, trip times shall not exceed the value shown in NETA ATS tables.

h. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

i. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

j. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

k. Pickup values and trip characteristics shall be within manufacturer's published tolerances.

l. Minimum pickup voltage of the shunt trip and close coils shall conform to the manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

m. Breaker open, close, trip, trip-free, anti-pump, and auxiliary features shall function as designed.

n. The charging mechanism shall operate in accordance with manufacturer's published data.

F. Low voltage air power circuit breakers - ANSI class breakers:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify that all maintenance devices are available for servicing and operating the breaker.

e. Verify the unit is clean.

f. Verify the arc chutes are intact.

g. Inspect moving and stationary contacts for condition and alignment.

h. Verify that primary and secondary contact wipe and other dimensions vital to satisfactory operation of the breaker are correct.

i. Perform all mechanical operator and contact alignment tests on both the breaker and its operating mechanism in accordance with manufacturer's published data.

j. Inspect bolted electrical connections for high resistance by one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

k. Verify cell fit and element alignment.

l. Verify racking mechanism operation.

m. Lubrication requirements:

1) Verify appropriate lubrication on moving current-carrying parts.

2) Verify appropriate lubrication on moving and sliding surfaces.

n. Perform adjustments for final protective device settings in accordance with the coordination study.

o. Record as-found and as-left operation counter readings.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance tests for 1 minute on each pole, phase-to-phase and phase to ground with the circuit breaker closed, and across each open pole:

1) Test voltage shall be in accordance with manufacturer's published data.

2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Perform a contact/pole-resistance test.

d. Perform insulation-resistance tests on control wiring with respect to ground. Applied potential shall be 500 VDC for 300-volt rated cable and 1,000 VDC for 600-volt rated cable. Apply the test voltage for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

e. Determine long-time pickup and delay by primary current injection.

f. Determine short-time pickup and delay by primary current injection.

g. Determine ground-fault pickup and delay by primary current injection.

h. Determine instantaneous pickup value by primary current injection.

i. Test functions of the trip unit by means of secondary injection.

j. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.

k. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function and trip unit battery condition:

1) Reset all trip logs and indicators.

l. Verify operation of charging mechanism.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Settings shall comply with coordination study requirements.

e. Operations counter shall advance one digit per close-open cycle.

f. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate values of insulation resistance less than the allowable minimum.

g. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:

1) If manufacturer's data in not available, investigate any values which deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.

h. Insulation resistance values of control wiring shall not be less than 2 megohms.

i. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band including adjustment factors:

1) If manufacturer's curves are not available, trip times shall not exceed the value shown in NETA ATS tables.

j. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

k. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.

l. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

m. Pickup values and trip characteristics shall be within manufacturer's published tolerances.

n. Minimum pickup voltage of the shunt trip and close coils shall conform to the manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

o. Auxiliary features shall operate in accordance with manufacturer's published data.

p. The charging mechanism shall operate in accordance with manufacturer's published data.

G. Instrument transformers:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Verify correct connection of transformers with system requirements.

d. Verify that adequate clearances exist between primary and secondary circuit wiring.

e. Verify the unit is clean.

f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

b) Thermographic survey.

g. Verify that all required grounding and shorting connections provide contact.

h. Verify correct operation of transformer withdrawal mechanism and grounding operation.

i. Verify correct primary and secondary fuse sizes for voltage transformers.

j. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

2. Electrical tests - current transformers:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance test of each current transformer and its secondary wiring with respect to ground at 1,000 VDC for 1 minute:

1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

c. Perform a polarity test of each current transformer in accordance with ANSI/IEEE C57.13.1.

d. Perform a ratio verification test using the voltage or current method in accordance with ANSI/IEEE C57.13.1.

e. Perform an excitation test on current transformers used for relaying applications in with accordance with ANSI/IEEE C57.13.1.

f. Measure current circuit burdens at transformer terminals in accordance with ANSI/IEEE C57.13.1.

g. When applicable perform insulation resistance tests on the primary winding with the secondary grounded:

1) Test voltages shall be in accordance with NETA ATS tables.

h. When applicable perform dielectric withstand tests on the primary winding with the secondary grounded:

1) Test voltages shall be in accordance with NETA ATS tables.

i. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturer's published data.

j. Verify that current transformer secondary circuits are grounded and have only 1 grounding point in accordance with ANSI/IEEE C57.13.3:

1) That grounding point should be located as specified by the ENGINEER in the Contract Documents.

3. Electrical tests - voltage transformers:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance tests winding-to-winding and winding-to-ground:

1) Test voltage shall be applied for 1 minute in accordance with NETA ATS requirements.

2) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.

c. Perform a polarity test on each voltage transformer to verify the polarity marks on H_1- X_1 relationship as applicable.

d. Perform a turns ratio test on all tap positions.

e. Measure voltage circuit burdens at transformer terminals.

f. Perform a dielectric withstand test on the primary windings with the secondary windings grounded:

1) The dielectric voltage shall be in accordance with NETA ATS tables.

2) Apply the test voltage for 1 minute.

g. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturers published data.

h. Verify that voltage transformer secondary circuits are grounded and have only 1 grounding point in accordance with ANSI/IEEE C57.13.3:

1) That grounding point should be located as specified by the ENGINEER in the Contract Documents.

4. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Insulation resistance values of instrument transformers shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

e. Polarity results shall agree with transformer markings.

f. Ratio errors shall be in accordance with ANSI/IEEE C57.13.

g. Excitation results for current transformers shall match the curve supplied by the manufacturer or be in accordance with ANSI/IEEE C57.13.1.

h. Measured burdens shall be compared to instrument transformer ratings.

i. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the current transformer primary winding is considered to have passed the test.

j. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the voltage transformer primary windings are considered to have passed the test.

k. Power-factor or dissipation-factor values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

l. Test results shall indicate that the circuits have only 1 grounding point.

H. Metering devices:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

d. Thermographic survey.

e. Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case shorting contacts as applicable.

f. Verify the unit is clean.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Verify accuracy of meter at all cardinal points.

c. Calibrate meters in accordance with manufacturer's published data.

d. Verify that current transformer, and voltage transformer secondary circuits are intact.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Meter accuracy shall be in accordance with manufacturer's published data.

e. Calibration results shall be within manufacturer's published tolerances.

f. Instrument multipliers shall be in accordance with system design specifications.

g. Test results shall confirm the integrity of the secondary circuits of current and voltage transformers.

I. Grounding systems:

1. Visual and mechanical inspection:

a. Inspect ground system for compliance with that indicated on the Drawings, specified in Specifications, and in the National Electrical Code.

b. Inspect physical and mechanical condition.

c. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

d. Inspect anchorage.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform fall of potential test or alternative test in accordance with ANSI/IEEE Standard 81 on the main grounding electrode or system.

c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, the system neutral and any derived neutral points.

3. Test values:

a. Grounding system electrical and mechanical connections shall be free of corrosion.

b. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

c. Bolt torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

d. The resistance between the main grounding electrode and ground shall be as specified in Section 16060. Investigate point-to-point resistance values that exceed 0.5 ohm.

J. Rotating machinery:

1. Visual and mechanical inspection:

a. Compare equipment nameplate information with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging.

e. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

b) Thermographic survey.

f. Perform special tests such as gap spacing and machine alignment if applicable.

g. Verify correct application of appropriate lubrication and lubrication systems.

h. Verify that resistance temperature detector (RTD) circuits conform to that indicated on the Drawings.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

b. Perform insulation resistance test in accordance with ANSI/IEEE 43:

1) On motors 200 HP and smaller, test duration shall be 1 minute. Calculate dielectric absorption ratio.

2) On motors larger than 200 HP, test duration shall be 10 minutes. Calculate polarization index.

c. Perform dc dielectric withstand voltage tests on machines rated at 2,300 volts and greater in accordance with ANSI/IEEE Standard 95.

d. Perform phase-to-phase stator resistance test on machines rated at 2,300 volts and greater.

e. Perform insulation power-factor or dissipation-factor tests.

f. Perform insulation resistance test on insulated bearings in accordance with manufacturer's published data.

g. Test surge protection devices as specified in this Section.

h. Test motor starter as specified in this Section.

i. Perform resistance tests on resistance temperature detector (RTD) circuits.

j. Verify operation of motor space heater.

k. Perform vibration test.

l. Perform a rotation test to ensure correct shaft rotation.

m. Measure running current and evaluate relative to load conditions and nameplate full-load amperes.

3. Test values:

a. Inspection:

1) Air baffles shall be clean and installed in accordance with the manufacturer's published data.

2) Filter media shall be clean and installed in accordance with the manufacturer's published data.

3) Cooling fans shall operate.

4) Slip ring alignment shall be within manufacturer's published tolerances.

5) Brush alignment shall be within manufacturer's published tolerances.

6) Brush rigging shall be within manufacturer's published tolerances.

b. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

c. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

d. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

e. Air-gap spacing and machine alignment shall be in accordance with manufacturer's published data.

f. The dielectric absorption ratio or polarization index shall not be less than 1.0. The recommended minimum insulation ($IR_{1\ min}$) test results

in megohms shall be corrected to 40 degrees Celsius and read as follows:

1) $IR_{1\ min}$ = 100 megohms for dc armature and ac windings with form-wound coils above 1 KV.

2) $IR_{1\ min}$ = 5 megohms for machines and random-wound stator coils and form-wound coils rated below 1 kV.

Note: Dielectric withstand voltage and surge comparison tests shall not be performed on machines having lower values than those indicated above.

g. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

h. Investigate phase-to-phase stator resistance values that deviate by more than 10 percent.

i. Power factor or dissipation factor values shall be compared to manufacturer's published data:

1) In the absence of manufacturer's published data compare values of similar machines.

j. Tip-up values shall indicate no significant increase in power factor.

k. If no evidence of distress, insulation failure or waveform nesting is observed by the end of the total time of voltage application during the surge comparison test, the test specimen is considered to have passed the test.

l. Bearing insulation resistance measurements shall be within manufacturer's published tolerances:

1) In the absence of manufacturer's published data compare values of similar machines.

m. Test results of surge protection devices shall be as specified in this Section.

n. Test results of motor starter equipment shall be as specified in this Section.

o. RTD circuits shall conform to the design intent and machine protection device manufacturer's published data.

p. Heaters shall be operational.

q. Vibration amplitudes shall not exceed values in NETA ATS tables:

1) If values exceed those in the NETA ATS tables, perform a complete vibration analysis.

r. Machine rotation should match required rotation of connected load.

s. Running phase-to-phase voltages should be within 1.0 percent. Running currents shall be balanced and proportional to load condition and nameplate data.

K. Motor starters, low voltage:

1. Visual and mechanical inspection:

   a. Compare equipment nameplate information with that indicated on the Drawings and specified in the Specifications.

   b. Inspect physical and mechanical condition.

   c. Inspect anchorage, alignment, and grounding.

   d. Verify the unit is clean.

   e. Inspect contactors:

      1) Verify mechanical operation.

      2) Verify contact gap, wipe, alignment, and pressure are in accordance with manufacturer's published data.

   f. Motor-running protection:

      1) Verify overload element rating is correct for its application.

      2) If motor running protection is provided by fuses, verify correct fuse rating.

   g. Inspect bolted electrical connections for high resistance using one of the following methods:

      1) Use of low resistance ohmmeter.

      2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:

         a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

      3) Thermographic survey.

   h. Lubrication requirements:

      1) Verify appropriate lubrication on moving current-carrying parts.

      2) Verify appropriate lubrication on moving and sliding surfaces.

2. Electrical tests:

   a. Perform resistance measurements through bolted connections with a low resistance ohmmeter.

   b. Perform insulation resistance tests for 1 minute on each pole, phase-to-phase and phase to ground with the starter closed, and across each open pole for 1 minute:

      1) Test voltage shall be in accordance with manufacturer's published data.

      2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Test motor protection devices in accordance with manufacturer's published data.

d. Test circuit breakers as specified in this Section.

e. Perform operational tests by initiating control devices.

3. Test values:

a. Compare bolted connection resistance values to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate values of insulation resistance less than the allowable minimum.

e. Insulation resistance values of control wiring shall not be less than 2 megohms.

f. Motor protection parameters shall be in accordance with manufacturer's published data.

g. Circuit breaker test results shall as specified in this Section.

h. Control devices shall perform in accordance with system design requirements.

L. Motor control centers, low voltage:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding and required clearances.

d. Inspect equipment for cleanliness.

e. Verify that circuit breaker/fuse sizes and types correspond to the approved submittals and coordination study.

f. Verify that current and voltage transformer ratios correspond to that indicated on the Drawings.

g. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

h. Mechanical and electrical interlocks:

1) Attempt closure on locked-open devices.

2) Attempt to open locked-closed devices.

3) Make/attempt key-exchanges in all positions.

i. Lubrication requirements:

1) Verify appropriate lubrication on moving current-carrying parts.

2) Verify appropriate lubrication on moving and sliding surfaces.

j. Inspect insulators for evidence of physical damage or contaminated surfaces.

k. Verify correct barrier and shutter installation and operation.

l. Exercise all active components.

m. Inspect all indicating devices for correct operation.

n. Verify that filters are in place and/or vents are clear.

o. Perform visual and mechanical inspection of instrument transformers as specified in this Section.

p. Inspect control power transformers:

1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.

2) Verify that primary and secondary fuse/circuit breaker ratings match the submittal drawings.

q. Perform visual and mechanical inspection of circuit breakers as specified in this Section.

r. Perform visual and mechanical inspection of starters as specified in this Section.

s. Perform visual and mechanical inspection of dry-type transformers as specified in this Section.

t. Perform visual and mechanical inspection of variable frequency drives as specified in this Section.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter if applicable.

b. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for 1 minute:

1) Perform test in accordance with NETA ATS tables.

c. Perform an dielectric withstand test on each bus section, each phase to ground with phases not under test grounded, in accordance with manufacturer's published data or NETA ATS tables. Apply the test voltage for 1 minute.

d. Perform ground-resistance tests:

1) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral and derived neutral points.

e. Determine the accuracy of all meters.

f. Control power transformers:

1) Perform insulation resistance tests, winding-to-winding and winding-to-ground:

a) Test voltages shall be in accordance with NETA ATS tables or as specified by the manufacturer.

2) Perform secondary wiring integrity test:

a) Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source:

(1) Verify correct potential at all devices.

3) Verify correct secondary voltage by energizing primary winding with system voltage:

a) Measure secondary voltage with the secondary wiring disconnected.

g. Verify operation of space heaters.

h. Perform electrical tests of circuit breakers as specified in this Section.

i. Perform electrical tests of starters as specified in this Section.

j. Perform electrical tests of dry-type transformers as specified in this Section.

k. Perform electrical tests of variable frequency drives as specified in this Section.

3. Test values:

a. Compare bus connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Compare bus connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Insulation-resistance values for bus and control power transformers shall be in accordance with manufacturer's published data:

a) Refer to NETA ATS tables in the absence of manufacturer's published data.

b) Investigate insulation values less than the allowable minimum.

c) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.

e. Bus insulation shall withstand the over-potential test voltage applied.

f. Insulation-resistance values for control wiring shall not be less than 2.0 megohms.

g. Instrument transformer test values shall be as specified in this Section.

h. Investigate grounding system resistance values that exceed 0.5 ohm.

i. Meter accuracy shall be in accordance with manufacturer's published data.

j. Control power transformers:

1) Insulation resistance values of control power transformers shall be in accordance with manufacturer's published data:

a) Refer to NETA ATS tables in the absence of manufacturer's published data.

b) Investigate insulation values less than the allowable minimum.

c) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.

2) Secondary wiring shall be in accordance with that indicated on the Drawings and specified in the Specifications.

3) Secondary voltage shall be in accordance with that indicated on the Drawings.

k. Heaters shall be operational.

l. Test values for circuit breakers shall be as specified in this Section.

m. Test values for starters shall be as specified in this Section.

n. Test values for dry-type transformers shall as specified in this Section.

o. Test values for variable frequency drives shall be as specified in this Section.

M. Variable frequency drive systems:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify the unit is clean.

e. Ensure vent path openings are free from debris and that heat transfer surfaces are clean.

f. Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.

g. Motor running protection:

1) Verify drive overcurrent setpoints are correct for their application.

2) If drive is used to operate multiple motors, verify individual overload element ratings are correct for their application.

3) Apply minimum and maximum speed setpoints. Verify setpoints are within limitations of the load coupled to the motor.

h. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

3) Thermographic survey.

i. Verify correct fuse sizing in accordance with manufacturer's published data.

j. Perform visual and mechanical inspection of input circuit breaker as specified in this Section.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with low-resistance ohmmeter.

b. Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.

c. Test for the following parameters in accordance with relay calibration procedures specified in this Section or as recommended by the manufacturer:

1) Input phase loss protection.

2) Input overvoltage protection.

3) Output phase rotation.

4) Over-temperature protection.

5) Direct current overvoltage protection.

6) Over frequency protection.

7) Drive overload protection.

8) Fault alarm outputs.

d. Perform continuity tests on bonding conductors as specified in this Section.

e. Perform start-up of drive in accordance with manufacturer's published data. Calibrate drive to the system's minimum and maximum speed control signals.

f. Perform operational tests by initiating control devices:

1) Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.

2) Verify operation of drive from remote start/stop and speed control signals.

g. Perform electrical tests of input circuit breaker as specified in this Section.

h. Measure the voltage and current 5th, 7th, 9th, 11th harmonics at the load side of the ATS with a harmonic analyzer with the each combination of pumps or as designated by Engineer at start-up in

operation on the Utility source and Generator source. Measure and record the results,

3. Test values:

a. Compare bolted connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Results of the thermographic survey shall be in accordance with NETA ATS requirements.

d. Overload test trip times at 300 percent of overload element rating shall be in accordance with manufacturer's published time-current curve.

e. Test values for input circuit breaker shall be as specified in this Section.

f. Insulation-resistance values for control wiring shall not be less than 2.0 megohms.

g. Relay calibration results shall be as specified in this Section.

h. Continuity of bonding conductors shall be as specified in this Section.

i. Control devices shall perform in accordance with system requirements.

j. Operational tests shall conform to system design requirements.

N. Surge arresters, low-voltage:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify the arresters are clean.

e. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use of low resistance ohmmeter.

2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:

a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

f. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

g. Verify that stroke counter is correctly mounted and electrically connected, if applicable.

h. Record stroke counter reading.

2. Electrical tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform an insulation-resistance test on each arrester, phase terminal-to-ground:

1) Apply voltage in accordance with manufacturers published data.

2) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Test grounding connection as specified in this Section.

3. Test values:

a. Compare bolted connection resistances to values of similar connections:

1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

c. Insulation resistance values shall be in accordance with manufacturer's published data:

1) Refer to NETA ATS tables in the absence of manufacturer's published data.

2) Investigate insulation values less than the allowable minimum.

d. Resistance between the arrester ground terminal and the ground system shall be less than 0.5 ohm.

O. Engine generator:

1. Visual and mechanical inspection:

a. Compare equipment nameplate data with that indicated on the Drawings and specified in the Specifications.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, and grounding.

d. Verify the unit is clean.

2. Electrical and mechanical tests:

   a. Perform insulation-resistance tests in accordance with ANSI/IEEE Standard 43:

      1) Machines larger than 150 kilowatts: Test duration shall be 10 minutes. Calculate polarization index.

      2) Machines 150 kilowatts and less: test duration shall be 1 minute. Calculate the dielectric-absorption rate.

   b. Test protective relay devices as specified in this Section.

   c. Verify phase rotation, phasing, and synchronized operation as required by the application.

   d. Functionally test engine shutdown for low oil pressure, over temperature, over speed, and other protection features as applicable.

   e. Perform vibration test for each main bearing cap.

   f. Conduct performance test in accordance with ANSI/NFPA 110.

   g. Verify correct functioning of governor and regulator.

3. Test values:

   a. Anchorage, alignment, and grounding should be in accordance with manufacturer's published data and system design.

   b. The dielectric absorption ratio or polarization index shall be compared to previously obtained results and should not be less than 1.0. The recommended minimum insulation ($IR_{1\ min}$) test results in megohms shall be corrected to 40 degrees Celsius and read as follows:

      1) IR1 min = kV + 1 for most windings made before 1970, all field windings, and others not described below.

         (kV is the rated machine terminal-to-terminal voltage in RMS kV).

      2) IR1 min = 100 megohms for most dc armature and ac windings built after 1970 (form-wound coils).

      3) IR1 min = 5 megohms for most machines and random-wound stator coils and form-wound coils rated below 1 kV.

         Note: Dielectric withstand voltage and surge comparison tests shall not be performed on machines having lower values than those indicated above.

   c. Protective relay device test results shall be as specified in this Section.

   d. Phase rotation, phasing, and synchronizing shall be in accordance with system design requirements.

e. Low oil pressure, over temperature, over speed, and other protection features shall operate in accordance with manufacturer's published data and system design requirements.

f. Vibration levels shall be in accordance with manufacturer's published data and shall be compared to baseline data.

g. Performance tests shall conform to manufacturer's published data and ANSI/NFPA Standard 110.

h. Governor and regulator shall operate in accordance with manufacturer's published data and system design requirements.

P. Fiber-optic cables:

1. Visual and mechanical inspection:

a. Compare cable, connector, and splice data with that indicated on the Drawings and specified in the Specifications:

b. Inspect cable and connections for physical and mechanical damage.

c. Verify that all connectors and splices are correctly installed.

2. Electrical tests:

a. Perform cable length measurement, fiber fracture inspection, and construction defect inspection using an optical time domain reflectometer:

1) OTDR test performed on fiber cables less than 100 meters shall be performed with the aid of a launch cable.

2) Adjust OTDR pulse width settings to a maximum setting of 1/1000th of the cable length or 10 nanoseconds.

b. Perform connector and splice integrity test using an optical time domain reflectometer.

c. Perform cable attenuation loss measurement with an optical power loss test set:

1) Perform attenuation tests with an Optical Loss Test Set capable and calibrated to show anomalies of 0.1 dB as a minimum.

2) Test multimode fibers at 850 nm and 1,300 nm.

3) Test single mode fibers at 1,310 nm and 1,550 nm.

d. Perform connector and splice attenuation loss measurement from both ends of the optical cable with an optical power loss test set:

1) At the conclusion of all outdoor splices at one location, and before they are enclosed and sealed, all splices shall be tested with OTDR at the optimal wavelengths (850 and 1,300 for multimode, 1,310 and 1,550 for single mode), in both directions. The splices shall be tested for integrity as well as attenuation.

e. Perform fiber links integrity and attenuation tests using each link shall be an OTDR and an Optical Loss Test Set:

1) OTDR traces shall be from both directions on each fiber at the 2 optimal wavelengths, 850 nm and 1,300 nm for multimode fibers.

2) Optical loss testing shall be done with handheld test sets in 1 direction at the 2 optimal wavelengths for the appropriate fiber type. Test equipment shall equal or exceed the accuracy and resolution of Agilent/HP 8147 high performance OTDR.

3. Test values:

a. Cable and connections shall not have been subjected to physical or mechanical damage.

b. Connectors and splices shall be installed in accordance with industry standards.

c. The optical time domain reflectometer signal should be analyzed for excessive connection, splice, or cable backscatter by viewing the reflected power/distance graph.

d. Attenuation loss measurement shall be expressed in dB/km. Losses shall be within the manufacturer's recommendations when no local site specifications are available.

e. Individual fusion splice losses shall not exceed 0.1 dB. Measurement results shall be recorded, validated by trace, and filed with the records of the respective cable runs.

Q. LAN (Cat 6, RS-485) cable testing:

1. Visual and mechanical inspections:

a. Compare cable type and connections with that indicated on the Drawings and specified in the Specifications.

b. Inspect cable and connectors for physical and mechanical damage.

c. Verify that all connectors are correctly installed.

2. Pre-testing:

a. Test individual cables before installation:

1) Before physical placement of the cable, test each cable while on the spool with a LAN certification test device.

2) Before the cable is installed, verify that the cable conforms to the manufacturer's attenuation specification and that no damage has been done to the cable during shipping or handling.

3) The test shall be fully documented and the results submitted to the ENGINEER, including a hard copy of all traces, before placement of the cable.

4) The ENGINEER shall be notified if a cable fails to meet specification and the cable shall not be installed unless otherwise directed by the ENGINEER.

3. Electrical tests:

a. Perform cable end-to-end testing on all installed cables after installation of connectors from both ends of the cable.

b. Test shall include cable system performance tests and confirm the absence of wiring errors.

4. Test results:

a. Cables shall meet or exceed TIA standards for a Category 6 installation.

5. Test equipment:

a. LAN certification equipment used for the testing shall be capable of testing Category 6 cable installation to TIA proposed Level III accuracy. Tests performed shall include:

1) Near end cross talk.

2) Attenuation.

3) Equal level far end cross talk.

4) Return loss.

5) Ambient noise.

6) Effective cable length.

7) Propagation delay.

8) Continuity/loop resistance.

b. LAN certification test equipment shall be able to store and produce plots of the test results.

c. Acceptable manufacturers: The following or equal:

1) Agilent Technologies, WireScope 350.

R. Radio Configuration and Testing

1. The Contractor shall install the radio and antenna system per the radio manufacturer's Installation Operation and Field Maintenance Manual. The Contractor shall pay for the services of radio manufacturer's qualified and qualified Radio Technician to perform the following Setup and Field Tests and perform any of the manufacturer's recommendations based on the results of the tests.

2. The Contractor shall notify the Owner or the Owner's representative one week in advance of the test in order to have all setup, tests, and adjustments performed by the Radio Technician witnessed by the Owner.

3. The Radio Technician shall perform the following as a minimum for the radio system:

a. System Address - The Contractor shall configure the radio using the diagnostic software to use a system address (other than the default address the radio is shipped with) as directed by Owner. The station radio operating mode shall be as a remote.

b. Data Rate - The communication's data rate shall be set to match existing radios.

c. Radio DC Voltage Check - The Contractor shall measure the supply voltage and adjust to the voltage rating with the transmitter keyed. During normal operation, re-measure the power supply voltage, and ensure that it does not drop below the minimum or above the maximum radio rating when switching between receive and transmit.

d. Transmitter Power Output - Under Section 15.247 of the FCC Rules, the radio power must be reduced to a level that results in an effective isotropic radiated power (EIRP) signal of the radio license. The EIRP is dependent on the radio transmit output power, the antenna feedline loss, and the antenna gain. Antenna gain shall be measured in the field utilizing the VSWR or forward/reflected power method. Follow the Manufacturer's recommended procedure to adjust the power output of the radio. Under no circumstances should the radio's system EIRP exceed the radio license.

3.03 ADJUSTING

A. Adjust limit switches and level switches to their operating points before testing. Confirm settings with ENGINEER.

B. Set pressure switches, flow switches, vibration switches and timing relays to anticipated values before testing:

1. Final settings shall be as dictated by operating results during testing and confirmed with ENGINEER.

3.04 CLEANING

A. As specified in Section 16050.

B. After the Field Acceptance Tests have been completed, dispose of all testing expendables, vacuum all cabinets and panel interiors, wipe down all electrical equipment, sweep clean all surrounding areas.

3.05 GENERAL START-UP AND TESTING PROCEDURES; FUNCTIONAL TESTING; TRAINING; AND OPERATIONAL TESTING

A. As specified in Section 16050 and Section 01750.

B. Testing Agency shall work with the CONTRACTOR during General Start-Up and Testing Procedures which includes all electrical field acceptance testing as outlined in this specification Section.

1. Before "Functional Testing" as defined in Section 01750 can begin:

a. Complete General Start-Up and Testing Procedures which includes all of the field acceptance testing outlined in this Section.

b. Demonstrate proper operation of all alarm and status contacts with proper setpoints as part of these electrical field acceptance testing procedures.

c. Adjust and calibrate all process and control devices as accurately as possible during field acceptance testing and set proper ranges.

2. Operate each system in its manual mode first.

a. “Systems”, as used in this Section, means individual pumps, conveyor systems, polymer feeders, switchgear, lighting control systems and other electrically operated or controlled equipment.

b. Demonstrate compliance with all Contract requirements.

c. Verify all interlocks.

d. Verify operation by testing on rung by rung basis for each Schematic Diagram for each system. This includes all vendor supplied equipment.

3. After each system has operated successfully in its manual mode, perform automatic and/or remote operations.

a. Verify that all features are fully operational and meet all Contract requirements.

b. Demonstrate all operating modes and sequences, including proper start and stop sequence of pumps, interlocks, proper operation of valves and proper speed control of VFDs.

C. Testing Agency shall also work with the CONTRACTOR as required during the Functional Testing phase, Training, and Operational Testing as required.

3.06 PROTECTION

A. As specified in Section 16050.

3.07 SCHEDULES

A. At least 90 days before commencement of any field acceptance testing as defined in this Specification, submit the testing procedures to the ENGINEER. Provide with acceptable testing levels and tolerances for all equipment to be tested based on manufacturer’s data and/or NETA Tables.

B. Refer to Section 01750 for further scheduling requirements.

END OF SECTION

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SECTION 17050

COMMON WORK RESULTS FOR PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. General requirements applicable to all Process Control and Instrumentation Work.
2. General requirements for process control and instrumentation submittals.
3. As specified in this Section, PLC programming and SCADA HMI software configuration shall be provided by the INSTRUMENTATION AND CONTROL SYSTEM CONTRACTOR, through the services of a consultant, hereinafter referred to as the PROGRAMMER.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01110 – Summary of Work.
   b. Section 01140 - Work Sequence and Constraints.
   c. Section 01320 - Progress Schedules and Reports.
   d. Section 01329 - Safety Plan.
   e. Section 01330 - Submittals.
   f. Section 01410 - Regulatory Requirements.
   g. Section 01410 - Quality Control.
   h. Section 01600 – Material and Equipment.
   i. Section 01750 - Testing, Training, and Facility Start-Up.

j. Section 01770 – Contract Closeout.

k. Section 01780 - Operation and Maintenance Data.

l. Section 16050 - Common Work Results for Electrical.

m. Section 16075 - Electrical Identification.

n. Section 16222 - Low Voltage Motors up to 500 Horsepower.

o. Section 17100 - Control Strategies.

p. Section 17101 - Specific Control Strategies.

q. Section 17761 - PLC Programming Software.

r. Section 17950 - Testing, Calibration, and Commissioning.

C. Interfaces to equipment, instruments, and other components:

1. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers, which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.

2. Provide all material and labor needed to install the actual equipment furnished, include all costs to add any additional instruments, wiring, control system inputs/outputs, controls, interlocks, electrical hardware etc., which may be necessary to make a complete, functional installation based on the actual equipment furnished:

   a. Make all changes necessary to meet the manufacturer's wiring requirements.

3. Submit all such changes and additions to the ENGINEER for acceptance as specified in Section 01600.

4. Review the complete set of Drawings and Specifications in order to ensure that all items related to the instrumentation and control systems are completely accounted for. Include any items that appear on Drawings or in Specifications from another discipline in the scope of Work:

   a. If a conflict between Drawings and Specifications is discovered, refer conflict to the ENGINEER as soon as possible for resolution.

5. Loop drawings:

   a. Provide complete loop drawings for all systems, including packaged equipment furnished as part of a vendor furnished package, and for all pre-purchased equipment.

   b. The form, minimum level of detail, and format for the loop drawings must match that of the sample loop drawings included in the Contract Documents.

   c. The OWNER and ENGINEER are not responsible for providing detailed loop diagrams for CONTRACTOR furnished equipment.

D. All instrumentation, and control equipment and systems for the entire project to comply with the requirements specified in the Instrumentation and Control Specifications, whether referenced in the individual Equipment Specifications or not:

1. The requirements of the Instrumentation and Control Specifications apply to all Instrumentation and Control Work specified in other Specifications, including HVAC controls, packaged mechanical systems, LCPs, VCPs, etc.

2. Inform all vendors supplying instrumentation, control systems, panels, and/or equipment of the requirements of the Instrumentation and Control Specifications.

3. The OWNER is not responsible for any additional costs due to the failure of the CONTRACTOR to notify all subcontractors and suppliers of the Instrumentation and Control Specifications' requirements.

E. Contract Documents:

1. General:

a. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work.

2. Specifications:

a. Section 01100 of the Contract Documents govern the Work.

b. These requirements are in addition to all General Requirements.

3. Contract Drawings:

a. The Instrumentation and Control Drawings show in a diagrammatic manner, the desired locations, and arrangements of the components of the Instrumentation Work. Follow the Drawings as closely as possible, use professional judgment and coordinate with the other trades to secure the best possible installation, use the entire Drawing set for construction purposes.

b. Locations of equipment, control devices, instruments, boxes, panels, etc. are approximate only, exercise professional judgment in executing the Work to ensure the best possible installation:

1) The equipment locations and dimensions indicated on the Drawings and elevations are approximate. Use the shop drawings to determine the proper layout, foundation, and pad requirements, etc. for final installation. Coordinate with all subcontractors to ensure that all instrumentation and control equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.

2) The CONTRACTOR has the freedom to select any of the named manufacturers as identified in the individual Specifications; however, the ENGINEER has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the

CONTRACTOR's responsibility to ensure that the equipment being furnished fits within the defined space.

c. Installation details:

1) The Contract Drawings include installation details showing means and methods for installing instrumentation and control equipment. For cases where typical details are not provided or compatible with an installed location, develop installation details that are necessary for completing the Work, and submit these details for review by the ENGINEER.

d. Schematic diagrams:

1) All controls are shown de-energized.

2) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.

3) Add slave relays, where required, to provide all necessary contacts for the control system or where needed to function as interposing relays for control voltage coordination, equipment coordination, or control system voltage drop considerations.

4) Mount all devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated.

5) Control schematics are to be used as a guide in conjunction with the descriptive operating sequences indicated on the Drawings or in the Specifications. Combine all information and furnish a coordinated and fully functional control system.

F. Alternatives:

1. Substitute item provisions as specified in Section 01600.

G. Changes and change orders:

1. As specified in Section 01105.

1.02 REFERENCES

A. Code compliance:

1. As specified in Section 01410:

a. The publications are referred to in the text by basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of Bid governs.

2. The following codes and standards are hereby incorporated into this Section:

a. American National Standards Institute (ANSI):

1) B16.5 - Pipe Flanges and Flanged Fittings.

b. American Petroleum Institute (API):

1) RP551 - Process Measurement Instrumentation.

2) RP552 - Transmission Systems.

3) RP553 - Refinery Control Valves.

4) RP554 - Process Instrumentation and Control.

5) RP555 - Process Analyzers.

6) RP556 - Fired Heaters & Steam Generators.

7) RP557 - Guide to Advanced Control Systems.

c. ASTM International (ASTM):

1) A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

d. FM Global (FM).

e. Institute of Electrical and Electronic Engineers (IEEE).

f. International Electrotechnical Commission (IEC)

g. International Electrical Testing Association (NETA).

h. International Organization for Standardization (ISO):

1) 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation and Servicing.

i. International Society of Automation (ISA):

1) 5.1 - Instrumentation Symbols and Identification.

2) 5.2 - Binary Logic Diagrams for Process Operations.

3) 5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.

4) 5.4 - Instrument Loop Diagrams.

5) 5.5 - Graphic Symbols for Process Displays.

6) 7.00.01 - Quality Standard for Instrument Air.

7) RP - 12.4 - Pressurized Enclosures.

8) 18.1 - Annunciator Sequences and Specifications.

9) 20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.

10) TR20.00.01 - Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations Updated with 27 New Specification Forms in 2004-2005.

11) 50.00.01 - Compatibility of Analog Signals for Electric Industrial Process Instruments.

12) 51.1 - Process Instrumentation Terminology.

13) RP60.3 - Human Engineering for Control Centers.

14) 71.01 - Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity.

15) 71.02 - Environmental Conditions for Process Measurement and Control Systems: Power.

16) 71.03 - Environmental Conditions for Process Measurement and Control Systems: Mechanical Influences.

17) 71.04 - Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants.

j. National Electrical Manufacturers Association (NEMA):

1) NEMA 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

k. National Fire Protection Association (NFPA):

1) 70 - National Electric Code (NEC).

2) 496 - Purged and Pressurized Enclosures for Electrical Equipment, where applicable.

3) 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

l. Underwriters Laboratories, Inc. (UL):

1) 508 - Industrial Control Equipment.

B. Compliance with Laws and Regulations:

1. As specified in Section 16050.

1.03 DEFINITIONS

A. Definitions of terms and other electrical and instrumentation considerations as set forth by:

1. International Society of Automation (ISA).

2. International Electro Technical Commission (IEC).

3. Institute of Electrical and Electronic Engineers (IEEE).

4. International Organization for Standardization (ISO).

5. Factory Mutual or FM Global (FM).

6. National Electrical Code (NEC).

7. National Electrical Testing Association (NETA).

8. National Fire Protection Association (NFPA).

9. National Institute of Standards and Technology (NIST).

10. Underwriter Laboratories (UL).

B. Specific definitions:

1. Control circuit: Any circuit operating at 120 volts alternating current (VAC) or direct current (VDC) or less, whose principal purpose is the conveyance of information (including performing logic) and not the conveyance of energy for the operation of an electrically powered device.

2. Panel: An instrument support system that may be either a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term “panel” in these Contract Documents is interpreted as a general term, which includes flat surfaces, enclosures, cabinets and consoles.

3. Power circuit: Any circuit operating at 90 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.

4. Signal circuit: Any circuit operating at less than 50 VAC or VDC, which conveys analog information or digital communications information.

5. Digital bus: A communication network, such as Modbus, or Ethernet, allowing instruments and devices to transmit data, control functions and diagnostic information.

6. 2-Wire transmitter (loop powered): A transmitter that derives its operating power supply from the signal transmission circuit and requires no separate power supply connections. As used in this Section, two-wire transmitter refers to a transmitter that provides 4 to 20 milliamperes current regulation of a signal in a series circuit with an external 24 VDC driving potential:

7. Modbus communications signal or both.

8. Powered transmitters: A transmitter that requires a separate power source (120 VAC, 240 VAC, etc.) in order for the transmitter to develop its signal. As used in this Section, the produced signal may be either a 4 to 20 milliampere current signal, a digital bus communications signal or both.

9. System supplier - As specified in ICSC Qualifications in the Quality Assurance article of this Section.

10. Modifications: Changing, extending, interfacing to, removing or altering an existing circuit.

C. Acronym definitions:

1. CCS: The SCADA central computer system (CCS) consisting of personal computers and software. The personal computer-based hardware and software system that includes the operator interface, data storage, data retrieval, archiving, alarming, historian, reports, trending, and other higher level control system software and functions.

2. DPDT: Double-pole, double-throw.

3. ES: Enterprise system: Computer based communications or data sharing system utilized for non-process control functions such as E-mail, sharing files, creating documents, etc.

4. FAT: Factory acceptance test.

5. HART: Highway addressable remote transducer.

6. HOA: Hand-Off-Auto control function that is totally PLC based. In the Hand mode, equipment is started or stopped, valves are opened or closed through operator direction under the control of the PLC software. In the Auto mode, equipment is started or stopped and valves are opened or closed through a control algorithm within the PLC software. In the Off mode, the equipment is prohibited from responding from the PLC control.

7. HMI: Human machine interface: PLC based operator interface device consisting of an alphanumeric or graphic display with operator input functionality. The HMI is typically a flat panel type of display mounted on the front of a PLC enclosure with either a touch screen or tactile button interface.

8. ICSC: Instrumentation and control system contractor (System Supplier): Subcontractor who specializes in the design, construction, fabrication, software development, installation, testing, and commissioning of industrial instrumentation and control systems.

9. IJB: Instrument junction boxes: A panel designed with cord sets to easily remove, replace or relocate instrument signals.

10. I/O: Input/Output.

11. IP: Internet protocol or ingress protection.

12. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.

13. LAN: Local area network: A control or communications network that is limited to the physical boundaries of the facility.

14. LOR: Local-Off-Remote control function. In the Remote mode, equipment is started or stopped, and valves are opened or closed through the PLC based upon the selection of the HOA. In the Local mode, equipment is started or stopped, valves are opened or closed based upon hardwired control circuits completely independent of the PLC with minimum interlocks and permissive conditions. In the Off mode, the equipment is prohibited from responding to any control commands.

15. NJB: Network junction box. An enclosure that contains multiple access points to various networks within the facility. Networks could be Ethernet, Ethernet/IP, Fieldbus, RIO etc.

16. OIT: Operator interface terminal: PC-based interface device used for operator interface with the SCADA system.

17. P&ID: Process and instrumentation diagram.

18. PC: Personal computer.

19. PCIS: Process control and instrumentation system: Includes the entire instrumentation system, the entire control system, and all of the Work specified in the Instrumentation and Control Specifications and depicted on the Instrumentation Drawings.

20. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.

21. PJB: Power junction box: An enclosure with terminal blocks that distribute power to multiple instruments.

22. PLC: Programmable logic controller.

23. RIO: Remote I/O device for the PLC consisting of remote I/O racks, or remote I/O blocks.

24. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.

25. SCADA: Supervisory control and data acquisition system: A general name for the computerized system that gathers and processes data from sensors and applies operational controls to the process equipment. It includes the PLCs and/or RTUs, HMI PLC-based operator interface units, related interconnecting communications systems, and the CCS operator interface and data management system.

26. SPDT: Single-pole, double-throw.

27. SPST: Single-pole, single-throw.

28. UPS: Uninterruptible power supply.

29. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, OIT, HMI, etc.

30. WAN: Wide area network: A control or communications network that extends beyond the physical boundaries of the facility.

1.04 SYSTEM DESCRIPTION

A. General requirements:

1. The Work includes everything necessary for and incidental to executing and completing the Instrumentation and Control System Work indicated on the Drawings and specified in the Specifications and reasonably inferable there from including but not limited to:

   a. Preparing hardware submittals for field instrumentation.

   b. Design, develop, and draft loop drawings, interconnection drawings, control panel designs, and all other drawing submittals specified in the Instrumentation and Control Specifications.

   c. Prepare the test plan, the training plan, and the spare parts submittals.

   d. Procure all hardware.

   e. Provide all PCIS system hardware and software.

   f. Fabricate panels.

   g. Perform factory tests on panels and equipment supplied by the System Supplier.

h. Perform bench calibration and verify calibration after installation.

i. Oversee and certify installation of the PCIS system.

j. Oversee, document, and certify loop testing.

k. Oversee, document, and certify system pre-commissioning.

l. Conduct the performance tests.

m. Prepare operation and maintenance manuals.

n. Conduct training classes.

o. Prepare Record Drawings.

p. Integrate the PCIS with instrumentation and control devices provided under other sections.

q. Develop all requisite loop drawings and Record Drawings associated with equipment provided under the Contract Documents and OWNER furnished and existing equipment.

r. Resolve signal, power, or functional incompatibilities between the PCIS and interfacing devices.

s. Perform all required corrective and preventative maintenance.

2. It is the intent of these Specifications that the entire electrical power, instrumentation, and control system be complete and operable. Provide all necessary material and labor for the complete system from source of power to final utilization equipment, including all connections, testing, calibration of all equipment furnished by others, as well as equipment furnished by the CONTRACTOR, whether or not specifically mentioned but which are necessary for successful operation.

3. The ICSC PROGRAMMER, shall provide the configuration and programming for parts of the PLC and PC based SCADA control system, as described below.

a. PLC and local MHI shall be programmed by the PROGRAMMER.

b. The CCS consisting of personal computers and SCADA software shall be configured by the PROGRAMMER.

c. All other PLCs and other programmable devices shall be programmed by the CONTRACTOR, either directly or through the services of other entities such as subcontractors, equipment suppliers, and packaged equipment suppliers (vendors).

d. The PROGRAMMER shall assist with the testing of the software provided by the PROGRAMMER, as specified in this Section and in Section 17950.

4. The ICSC, shall also supply miscellaneous software listed below. The software listed is for the exclusive use of the CONTRACTOR and PROGRAMMER for this project, and shall not be made available for use by the CONTRACTOR. Additional software of similar make and model shall be provided by the CONTRACTOR, as needed to complete the SCADA

system and all other portions of the Work shown or specified. CONTRACTOR shall supply:

a. All new operator workstation SCADA system clients (hardware).

b. HMI development software.

c. Microsoft and SCADA application software for the Plant SCADA system.

5. Coordinate all aspects of the Work between CONTRACTOR and all subcontractors before bidding to ensure that all costs associated with a complete installation are included. The OWNER is not responsible for any change orders due to lack of coordination of the Work between the CONTRACTOR, the ICSC, the other subcontractors or suppliers.

6. Furnish detailed, complete, and thorough operations and maintenance documentation, including but not limited to operations manuals, maintenance manuals, as-built wiring drawings, training manuals, as-built software documentation, and all other documentation required to operate, modify, and maintain all parts of the PCIS.

7. The PROGRAMMER will provide as-built software documentation for the PLCs and computers programmed by the PROGRAMMER. The PROGRAMMER shall provide training on hardware and software items provided by the PROGRAMMER. All other documentation and training shall be by the CONTRACTOR.

8. Revise in a manner as directed by the ENGINEER all I/O and addressing that the ENGINEER determines to be unacceptable as a result of a lack of CONTRACTOR coordination between Contract Documents and all suppliers.

9. Defective Work:

a. As specified in Section 01410.

B. Programming Meetings

1. Before beginning SCADA software development for each process area, meet with the Owner for a four-hour Design Definition Meeting at the Owner's facility.

a. Ensure that the Contractor Project Manager, ICSC Engineer, ICSC SCADA & PLC software programmer, Engineer & Owner are in attendance.

b. Discuss SCADA & PLC format, programming and setup requirements to ensure that parties involved have a clear understanding of the Contract requirements. This discussion is to cover graphic screen layout, color conventions, text display menu system, PLC ladder logic etc.

c. ICSC to provide schedule for Preliminary Design Review and Critical Design Review.

d. Verify units of measurement (i.e. gpm) with Owner for each analog input.

e. Meeting shall occur 10 weeks prior to factory test.

2. Meet with the Owner for a 4-hour SCADA & PLC Preliminary Design Review meeting at the Owner's facility each process area.

   a. Ensure that the Contractor Project Manager, ICSC Engineer, ICSC SCADA & PLC software programmer, and Engineer & Owner are in attendance.

   b. Provide SCADA & PLC software preliminary design submittals for review and discussion 10 working days prior to meeting.

   c. ICSC to demonstrate SCADA screen color and graphic layout by bringing a configured PLC and PC loaded with SCADA graphics to the meeting.

   d. ICSC to demonstrate complete understanding of PLC control sequence of operations and SCADA setup.

   e. ICSC to assign action items with required completion date. Contractor to submit report of completed action items to the Owner on or before designated date.

   f. Meeting shall occur 6 weeks prior to factory test.

3. Meet with the Owner for a 4-hour SCADA & PLC Critical Design Review meeting at the Owner's facility prior to start of any factory test each process area.

   a. Ensure that the Contractor Project Manager, ICSC Engineer, ICSC SCADA & PLC software programmer, and Engineer and Owner are in attendance.

   b. Provide preliminary SCADA & PLC Software Operations and Maintenance Manual.

   c. ICSC to demonstrate the complete SCADA & PLC setup. All station display and setpoint parameters will be checked for completeness by bringing PC and PLC both fully programmed & setup to the meeting.

   d. ICSC to demonstrate all SCADA screens for review and comment.

   e. Demonstrate that all software correctly implements the sequence of operations and control strategies.

   f. ICSC to assign action items with required completion date. Contractor to submit report of completed action items to the Owner on or before designated date.

   g. Meeting shall occur two weeks prior to factory test.

C. No passwords shall be enabled on PLC/SCADA software or hardware developed for this project. All electronic disk copies provided to Owner shall not have any password protection enabled on them or the software. Software submitted with password protection will be removed by Owner and the Contractor will be backcharged for the cost thereof.

D. The Contractor shall include in his bid price an additional 180 hours of PLC program and SCADA Operator Interface graphic changes to be determined during

testing and start-up by the Owner. Any hour usage shall be made after written approval by Owner. Programming changes made during factory testing shall not be deducted from these hours unless agreed upon by Engineer. Field program changes shall be made by original programmer within five (5) working days after notification in writing by Engineer. Failure of programmer to respond and make requested program changes within these five (5) working days will result in Owner hiring another programmer and backcharging the Contractor $200.00 for each hour of the other programmer's time plus travel expenses. All programming configuration changes shall be performed by the original programmer and shall be made as directed by the Engineer in writing. A weekly report shall be prepared by ICSC listing extra hour utilized, dates when work was done, description of work performed, and remaining number of extra hours. None of the hours shall be used for documentation, paperwork, travel, overhead, construction management, etc. that are not related to programming changes since this is included in the hourly rate without written approval from Engineer. All hours not used shall be allocated for additional PLC program changes as directed by Owner during the one year warranty period.

E. Extra programming hours can be used for control strategy detail meeting with Engineer if held prior to start of writing PLC code for each Control Strategy.

F. It is the ICSC's responsibility to obtain SCADA/PLC and OI configuration software, licenses, manuals, and disks necessary for the ICSC to program and configure the SCADA/PLC & OI. Owner's configuration software, manuals and disks shall not be available to the ICSC for use.

G. Contractor shall modify PLC/SCADA analog input ranges and setpoints, from those listed in Section 17903 Schedules - I/O List, at the direction of the Engineer/Owner to match operating conditions at no additional cost to the Owner.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330, Section 16050 and this Section.

B. General:

1. Instruct all equipment suppliers of submittals and operation and maintenance manuals of the requirements in this Section.

2. Furnish the submittals required by each section in the Electrical Specifications.

3. Adhere to the wiring numbering scheme specified in Section 16075 throughout the Project:

   a. Uniquely number each wire.

   b. Wire numbers must appear on all Equipment Drawings.

4. Use equipment and instrument tags, as indicated on the Drawings, for all submittals.

5. Request for information (RFIs) shall not be included in submittals. RFIs shall be submitted separately in its individual submittal number.

C. Submittal organization:

1. First page:

   a. Specification section reference.

   b. Name and telephone number of individual who reviewed submittal before delivery to ENGINEER.

   c. Name and telephone number of individual who is primarily responsible for the development of the submittal.

   d. Place for CONTRACTOR's review stamp and comments.

2. Next pages:

   a. A copy of the appropriate Division Specification Sections, with addendum updates included and with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

      1) Check marks (√) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated and, therefore, requested by the Contractor, each deviation shall be underlined and denoted by a unique number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the Specifications.

      2) The submittal shall be accompanied by a detailed, written justification for each numbered item explaining variance or non-compliance with specifications.

      3) Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no review.

   b. Include a response in writing, on Company letterhead, to each of the ENGINEER's comments or questions for submittal packages which are re-submitted:

      1) In the order that the comments or questions were presented throughout the submittal.

      2) Referenced by index section and page number on which the comment appeared.

      3) Acceptable responses to ENGINEER's comments are either:

         a) ENGINEER's comment or change is accepted and appropriate changes are made.

         b) Explain why comment is not accepted or requested change is not made.

c) Explain how requirement will be satisfied in lieu of comment or change requested by ENGINEER.

4) Any re-submittal, which does not contain responses to the ENGINEER's previous comments shall be returned for Revision and Re-submittal.

5) No further review by the ENGINEER will be performed until a response for previous comments has been received.

3. Remaining pages:

a. Actual submittal data:

1) Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is intended to be used.

D. Submittal preparation:

1. During the period of preparation of submittals, the CONTRACTOR shall authorize direct, informal liaison between the ICSC and the ENGINEER for exchange of technical information. As a result of this liaison, certain minor refinements and revisions may be authorized informally by the ENGINEER, which do not alter the scope of Work or cause increase or decrease in the Contract price or times. During this informal exchange, no oral statement by the ENGINEER shall be construed to give formal approval of any component or method, nor shall any statement be construed to grant exception to, or variation from, these Contract Documents.

2. In these Contract Documents, some items of Work are represented schematically, and are designated for the most part by numbers, as derived from criteria in ANSI/ISA S5.1:

a. Employ the nomenclature and numbers designated in this Section and on the Drawings exclusively throughout shop drawings, data sheets, and similar submittals.

b. Replace any other symbols, designations, and nomenclature unique to a manufacturer's, suppliers, or subcontractor's standard methods with those identified in this Section and on the Drawings.

E. Specific submittal requirements:

1. Shop drawings:

a. Required for materials and equipment listed in this and other sections.

b. Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.

c. Shop drawings requirements:

1) Front, side, and, rear elevations, and top and bottom views, showing all dimensions and drawn to scale.

2) Locations of conduit entrances and access plates.

3) Component layout and identification.

4) Schematic and wiring diagrams with wire numbers and terminal identification.

5) Connection diagrams, terminal diagrams, internal wiring diagrams, conductor size, etc.

6) Anchoring method and leveling criteria, including manufacturer's recommendations for the Project site seismic criteria.

7) Weight.

8) Finish.

9) Nameplates:

a) As specified in Section 16075.

10) Temperature limitations, as applicable.

11) Latching mechanism.

12) Fans and ventilation system.

d. Use equipment and instrument tags as depicted on the P&IDs for all submittals.

e. Adhere to wiring numbering scheme outlined in Section 16075 throughout the Project:

1) Uniquely number each wire per the Specifications.

f. Wire numbers must appear on all equipment drawings.

g. Organize the shop drawing submittals for inclusion in the Operation and Maintenance Manuals:

1) Furnish the initial shop drawing submittal bound in one or more standard size, 3-ring, D-ring, loose leaf, vinyl plastic, hard cover binders suitable for bookshelf storage.

2) Binder ring size: 2 inches.

3) Provide additional binders such that when all material is inserted, the binders are not over 3/4 full

h. Include the letterhead and/or title block of the firm responsible for the preparation of all shop drawings. Include the following information in the title block, as a minimum:

1) The firm's registered business name.

2) Firm's physical address, email address, and phone number.

3) OWNER's name.

4) Project name and location.

5) Drawing name.

6) Revision level.

7) Personnel responsible for the content of the drawing.

8) Date.

i. The work includes modifications to existing circuits:

1) Clearly show all modifications to existing circuits.

2) In addition, show all existing unmodified wiring to clearly depict the functionality and electrical characteristics of the complete modified circuits.

2. Electrical One Line Diagrams:

a. Submit electrical one or three line diagrams detailing all devices associated with the power distribution system.

b. The following applicable information or data shall be shown on the one-line diagram:

1) Location

2) Size and amperage rating of bus

3) Size and amperage rating of wire or cable

4) Breaker ratings - Number of poles, and frame sizes;

5) Automatic transfer switch

6) Utility metering - voltage, amperage, number of wires and phases; fault interrupt ratings; ground size and connections; neutral size and connections

7) Power fail and other protective devices

8) Fuse size and type

9) Distribution transformer

10) Panelboard

11) Starters; contactor size and overload range

12) Motor full load amperage of submitted motor and horsepower; rating for miscellaneous loads; etc.

c. Submit a list for each piece of equipment containing the motor voltage, phase and full load amps with one-lines for verification of accuracy of submitted one-line drawings.

3. Elementary diagrams:

a. Elementary diagrams shall be provided for all relay logic, power supplies, PLC I/O and other wiring.

b. All elementary diagrams shall be drawn in JIC EMP/EGP format and standards similar to those shown on the E-series elementary diagrams showing ladder rung numbers and coil and contact cross referencing numbers.

4. Product data:
    a. Submitted for non-custom manufactured material listed in this and other sections and shown on shop drawings.
    b. Include:
        1) Catalog cuts.
        2) Bulletins.
        3) Brochures.
        4) Quality photocopies of applicable pages from these documents.
        5) Identify on the data sheets the Project name, applicable specification section, and paragraph.
        6) Identify model number and options for the actual equipment being furnished.
        7) Neatly cross out options that do not apply or equipment not intended to be supplied.
        8) Manufacturer's original electronic file on CD-ROM time-current characteristic curves for all fuses, circuit breakers, and protective relays in 11-inch by 17-inch format.
    c. Use equipment and instrument tags as depicted on the P&IDs for all submittals.
    d. Adhere to wiring numbering scheme outlined in Section 16075 throughout the Project:
        1) Uniquely number each wire per the Specifications.
    e. Wire numbers must appear on all equipment drawings.
5. Detailed sequence of operation for all equipment or systems.
6. Completed Motor Data Sheet, as specified in Section 16222, for every motor furnished:
    a. Submit one copy of the Motor Data Sheet to the ENGINEER for review as part of the associated equipment submittal.
7. Material and equipment schedules:
    a. Furnish a complete schedule and/or matrix of all materials, equipment, apparatus, and luminaries that are proposed for use:
        1) Include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
8. Itemized instrument summary:
    a. Submit a hard copy of the instrument summary.
    b. List all of the key attributes of each instrument including:
        1) Tag number.
        2) Manufacturer.

3) Model number.

4) Service.

5) Area location.

6) Calibrated range.

7) Loop drawing number.

c. Associated LCP, VCP, PCM, or PLC.

9. Instrument data sheets and cut sheets:

a. Furnish fully completed data sheets, both electronically in Microsoft Word or Excel and in hardcopy, for each instrument and component according to ISA S20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves. The data sheets provided with the instrument specifications are preliminary and are not complete. They are provided to assist with the completion of final instrument data sheets. Additional data sheets may be required. Include the following information on the data sheet:

1) Component functional description specified in this Section and indicated on the Drawings.

2) Manufacturers model number or other product designation.

3) Tag number specified in this Section and indicated on the Drawings.

4) System or loop of which the component is a part.

5) Location or assembly at which the component is to be installed.

6) Input and output characteristics.

7) Scale range with units and multiplier.

8) Requirements for electric supply.

9) Requirements for air supply.

10) Power consumption.

11) Response timing.

12) Materials of construction and of component parts that are in contact with, or otherwise exposed to, process media, and or corrosive ambient air.

13) Special requirements or features, such as specifications for ambient operating conditions.

14) Features and options that are furnished.

b. Provide a technical brochure or bulletin (“cut sheet”) for each instrument on the project. Submit with the corresponding data sheets:

1) Where the same make and model of instrument is used in 2 or more applications on the project, and the process applications are nearly identical, and the materials, features and options are identical submit one brochure or bulletin for the set of identical instruments.

2) Include a list of tag numbers for which it applies with each brochure or bulletin.

3) Furnish technical product brochures that are complete enough to verify conformance with all Contract Document requirements, and to reflect only those features supplied with the device.

4) Cross out models, features, options, or accessories that are not being provided.

5) Clearly mark and identify special options and features.

c. Organization: Index the data sheets and brochures in the submittal by systems or loops.

10. Control panel hardware submittal:

a. Submit the following in one submittal package.

b. Complete and detailed bills of materials:

1) Including quantity, description, manufacturer, and part number for each assembly or component for each control panel.

2) Include all items within an enclosure.

c. Complete grounding requirements for each system component including any requirements for PLCs, process LANs, and SCADA equipment.

d. Requirements for physical separation between control system components and 120 VAC, 480 VAC, and medium voltage power cables.

e. UPS and battery load calculations to show that the backup capacity and time meet the specified requirements.

f. Provide a data sheet for each control system component together with a technical product brochure or bulletin, which include:

1) The manufacturer's model number or other identifying product designation.

2) Tag and loop number.

3) System to which it belongs.

4) Site to which it applies.

5) Input and output characteristics.

6) Requirements for electric power.

7) Device ambient operating requirements.

8) Materials of construction.

11. Summary of Work:

a. In addition to completing all items referred to in the Summary of Work, Section 01110, submit per unit instrument and labor costs used in developing the final bid for the PCIS system, for the express purpose of pricing and cost justification for any proposed change orders. It is the responsibility of the ICSC subcontractor to prove to the ENGINEER's satisfaction that said per unit costs were used in the development of the final Bid amount.

12. Loop Drawings:

a. Submit loop drawings for every analog, discrete, and fieldbus signal and control circuit:

1) Provide a loop drawing submittal that completely defines and documents the contents of each monitoring, alarming, interlock, and control loop on this Project.

2) This requirement applies to all signal and control circuits associated with equipment on this Project including vendor supplied equipment packages and control panels.

b. Show every instrument and I/O point on at least one loop diagram.

c. Provide a complete index in the front of each bound volume:

1) Index the loop drawings by systems or process areas.

d. Provide drawings showing definitive diagrams for every instrumentation loop system:

1) Show and identify each component of each loop or system using requirements and symbols from ANSI/ISA S5.4 - Instrument Loop Drawings as amended by the Contract Drawings, as defined by the most recent revision in ISA. Include all minimum and optional ISA S5.4 content and information.

2) Furnish a separate drawing sheet for each system or loop diagram.

e. In addition to the ISA S5.4 requirements, show the following details:

1) Functional name of each loop.

2) Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.

3) Show all terminal numbers, regardless of the entity providing the equipment.

4) MCC panel, circuit, and breaker numbers for all power feeds to the loops and instrumentation.

5) Designation of and, if appropriate, terminal assignments associated with, every manhole, pull-box, junction box, conduit, and panel through which the loop circuits pass.

6) Show vendor control panel, instrument panel, conduit, junction box, equipment and PCIS terminations, termination identification, wire numbers and colors, power circuits, and ground identifications.

7) If a circuit is continued on another drawing, show the name and number of the continuation drawing on the loop drawing. Provide complete references to all continuation drawings whether vendor control panels, other loop drawings, existing drawings provided by the OWNER, or other drawings.

8) List associated interconnection drawings in the “Reference Document Table” of the loop drawing.

f. In addition to the above requirements, provide loop diagrams in accordance with the example loop diagram as indicated on the Drawings.

13. Instrument Installation Drawings:

a. Submit, instrument installation, mounting, and anchoring details for all components and assemblies, including access requirements and conduit connection or entry details.

b. Furnish for each instrument a dedicated 8 1/2-inch by 11-inch installation detail that pertains to the specific instrument by tag number.

c. For each detail, provide certification and the hard copies, by the instrument manufacturer, that the proposed installation is in accordance with the instrument manufacturer's recommendations and is fully warrantable.

d. For each detail, provide, as a minimum, the following contents:

1) Necessary sections and elevation views required to define instrument location by referencing tank, building or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor, etc.

2) Ambient temperature and humidity where the instrument is to be installed.

3) Corrosive qualities of the environment where the instrument is to be installed.

4) Hazardous rating of the environment where the instrument is to be installed.

5) Process line pipe or tank size, service and material.

6) Process tap elevation and location.

7) Upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.

8) Routing of tubing and identification of supports.

9) Mounting brackets, stands, anchoring devices, and sun shades.

10) Conduit entry size, number, location, and delineation between power and signal.

11) NEMA ratings of enclosures and all components.

12) Clearances required for instrument servicing.

13) List itemizing all manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.

14. Control Panel Drawings:

a. Layout Drawings:

1) Submit panel, enclosure, console, furniture, and cabinet layout drawings for all items provided.

2) As a minimum, include the following information:

a) To scale front, side, and plan views.

b) Dimensions.

c) Interior and exterior arrangements.

d) Mounting information, including conduit entrance location.

e) Finish data.

f) Tag number and functional name of items mounted in and on each panel, console, and cabinet.

g) Nameplate legend including text, letter size, and colors.

b. Wiring and Piping Diagrams:

1) Submit panel wiring and piping diagrams for every panel that contains wiring and/or piping.

2) Include the following information:

a) Name of panel.

b) Wiring and piping sizes and types.

c) Terminal strip numbers.

d) Wire tags and labels.

e) Functional name and manufacturer's designation for items to which wiring and piping are connected.

f) Electrical control schematics in accordance with ANSI standards.

c. Installation drawings:

1) Provide site-specific installation drawings for all control equipment panels, including dimensions.

2) Provide scaled drawings and show the position of the equipment at its intended installation location.

3) Show the placement of all equipment being provided under this Contract and its spatial relationship to all other equipment located in the abutting and adjoining areas.

4) Show all required access and clearances associated with the equipment with a statement of compliance to manufacturer's recommendations, NEC, and other applicable codes.

15. Schematic Diagrams:

a. Submit schematic diagrams for all electrical equipment in ladder diagram format.

b. Include device and field connection terminal numbers on all schematic diagrams.

c. Incorporate equipment manufacturer’s shop drawing information into the schematic diagrams in order to document the entire control system.

16. Control System Diagram:

a. Submit a complete set of control system diagrams including the following information:

1) All PLCs, workstations, printers, communication devices, and communication links:

a) Show all PLCs with their current I/O allocation, and future I/O allocation, current plus spares provided, and maximum potential I/O based on available slots.

2) All cables required for communication requirements.

3) Show each component fully annotated with conduit size and number associated with the power source.

17. Interconnection Diagram:

a. Diagrams shall show for each piece of equipment all wiring between all devices, panels, cabinets, terminal boxes, control equipment, motor control centers and any other devices and equipment. An interconnection diagram shall be furnished for each electrical and instrumentation system, even if one was not shown explicitly on the Contract Drawings. Interconnection diagrams shall be prepared for all conduits listed in the “Conduit and Wire Routing Schedule”. Each interconnection diagram shall show the following as a minimum:

1) Interconnect drawings shall be prepared for all equipment by the System Supplier.

2) The diagrams shall be utilized by the electrician during all phases of installation and connection of all conductors to ensure coordination of equipment interconnects.

3) The diagrams shall show wiring as field labeled at the end of the project when as-builts are submitted.

4) Each wire labeling code as actually installed shall be shown. The wiring labeling code for each end of the same wire must be identical.

5) All device and equipment labeling codes shall be shown.

6) Interconnections shall be shown point to point with identified lines. Diagrams of the wireless or wire schedule type are not acceptable. Bundled wires shall be shown as a single line with the direction of entry/exit of individual wires clearly shown. Interconnect diagrams shall not be combined with loop or elementary diagrams.

7) All terminations points on the diagram shall be shown with the actual equipment identification terminal number or letter. This identification of terminations includes terminal blocks, junction boxes, all devices, computer I/O points, etc.

8) Diagrams shall include raceway numbers, raceway size, raceway type, cable numbers, wire color code, and wire numbers.

9) Each wire size, and cable size and color code shall be shown. Each conduit with the conduit label and conduit size and wire fill shall be shown. Wire and cable routing through conduits, wireways, manholes, handholes, junction boxes, terminal boxes and other electrical enclosures shall be shown with the appropriate equipment labels. All spare wires, cable, and termination points shall be shown. Cable shields shall be shown.

10) Labeling codes for terminal blocks, terminals, wires, cables, panels, cabinets, instruments, devices, and equipment shall be shown. Place “øA”, “øB”, and “øC” label next to each breaker to identify phase connected to.

11) Schematic symbols shall be used for field devices, showing electrical contacts. Signal and DC circuit polarities shall be shown.

12) The diagrams shall show all other Contract and Supplier Drawing numbers, for reference, that are associated with each device that is interconnected.

13) Attached to each interconnect, a copy of all the support documents used in preparing interconnects shall be submitted. This includes current issues of panel schematics, elementary diagrams, panelboard schedules, conduit schedules, one-line diagrams, connection diagrams, terminal block diagrams, submittals, contract

drawings, vendor drawings and all other data used to develop the interconnection diagram as noted in the "Reference Documents" corner of interconnect drawings.

14) Interconnects shall include list of all applicable reference drawings, request for clarifications, field instructions and change orders. All deletions and additions of equipment, wire and cables shall be clearly shown.

15) Field wiring shall not start before the interconnection Drawing has been submitted by the Contractor and approved by the Owner.

16) Do not show the same wires or jumpers, or panel wiring on both the connection and interconnection diagrams. All jumper, shielding, and grounding termination details not shown on the connection diagrams shall be shown on the interconnection diagrams.

17) Interconnection diagrams shall be submitted and approved by Owner for each electrical and instrumentation system. The Contractor shall not pull in any wires into conduits that do not have approved interconnects. If the Contractor pulls in wire without Owner approval of associated Interconnect Drawings, the Contractor will not be reimbursed for labor for re-pulling in wires even if there was an error in wire fill or sizing. Also, if the Contractor pulls in wire without Owner approval of associated Interconnect Drawings, then all progress payments related to field wiring for that particular area of work will be withheld until approved Interconnect Drawings are in use.

18) All interconnection diagrams shall be prepared by a System Supplier under the supervision of or by a State of California Registered Electrical Engineer and shall bear that Engineer's professional stamp and signature for all Interconnection Drawings submitted for approval including as-builts and those used in the field installation. All deletions and additions of equipment, wire, and cables shall be clearly shown. Interconnects shall include list of all applicable reference Drawings, request for clarifications, field instructions, and change orders. Failure to provide backup references or signed and stamped drawings may be grounds for immediate rejection.

19) Example format of Interconnection diagram is shown on Contract "E" Series Drawings or may be obtained from the Engineer.

20) All Interconnection wires listed in the conduit schedule for each conduit shall be shown only on one interconnect drawing. Interconnect drawings submitted with wiring of a single conduit run separated onto multiple interconnect drawings will be rejected without review. A single conduit

run with wiring shown on separate interconnect drawings will be allowed only after written approval is given by the Engineer for each conduit run prior to submitting the associated interconnect drawings.

21) Only field wiring between MCCs, Panelboards, Control Panels, and other electrical and instrumentation devices or equipment shall be shown on interconnection drawings. No internal panel wiring shall be shown on interconnect drawings except jumper or other wiring to be installed in field by Electrical Contractor.

22) Interconnect Drawings along with the corresponding support documents shall be submitted in a separate submittal package. Interconnect drawings submitted with non-interconnect drawing packages will be rejected. The latest support documents shall be obtained by system supplier from Contractor for all non-division 16 instruments, panels, and equipment, and included with interconnect drawing submittal. Support documents shall have their submittal number marked in upper right hand corner.

23) Interconnect drawings shall be prepared for all equipment by the System Supplier.

24) Provide a notes section on each interconnect drawing. In the note section, list any variances from the Contract conduit schedule necessary for completing the interconnections. Change orders regarding wire fill, conduit schedule and errors in plans regarding conduits and wires will not be processed until interconnect drawings have been received for such work.

25) The field electrician shall mark-up all interconnection diagrams during installation to show accurate as-built wiring, conduits runs, terminations, etc. If interconnection drawings are not properly as-built, the Electrical Contractor will have cost deducted from the Contract for the Owner to field verify and prepare as-built interconnection drawings. The amount of the deduction shall be determined on a time and material basis. The cost of such work shall be $120.00 per hour plus expenses.

26) The System Supplier shall be responsible to collect all information necessary to complete each interconnection drawing. This includes making field trips to collect all terminal connection data for new and existing, panels, switchboards, panelboards, instruments, equipment and electrical panels.

27) An index of drawings shall be provided with each Interconnection submittal listing the unique drawing number and the description of the interconnect drawing (e.g. Drawing 4321-IC1004 Pump 1004 Interconnect Drawing).

28) Provide conduit and interconnect drawing cross reference indexes. Interconnect Conduit Index shall list all conduits listed in the Conduit & Wire Routing schedule and its associated Interconnection Drawing number. An Interconnection Drawing Index shall list all Interconnection drawings and the conduits shown on that specific drawing. These two indexes shall be at the front of all interconnection drawing submittals.

29) Interconnection submittals that contain more than two motor control panels/centers shall have heavy duty dividers with permanent plastic labeled index tabs separating each group of drawings.

18. Process Control & SCADA Software Submittal:

a. In accordance with Product Data and Shop Drawing general requirements.

b. Submit a complete description of the standard application software programs, operating system and utility programs, including modifications and explanation of how the specific functional requirements are met:

1) Provide a cross-reference between the Specification requirements and the software submittal, in order to provide the ENGINEER the ability to identify how each specified requirement or function is met.

c. A complete listing of the PCIS system point I/O database:

1) Include for each data point, relevant parameters such as range, contact orientation, limits, incremental limits, I/O card byte, I/O hardware address, and PLC assignment.

2) Organize on a site-by-site basis, separate by point type.

3) In addition to the active I/O points, list the implemented spare I/O points and the available I/O points remaining on each card, as well as other defined future points specified or shown.

d. Detailed descriptions of procedures used to implement and modify control strategies and database construction.

e. Preliminary overview, screens, station graphic displays, and preliminary reports.

f. Refer to Section 17761 for additional requirements.

19. Instrumentation and Control System Contractor Statement of Qualifications:

a. Submit statement of qualifications of the proposed ICSC in accordance with subsequent requirements of this Section.

20. Control Descriptions:

a. For each control loop, provide a detailed functional description of the operation of the equipment, signals, and controls as shown on the P&IDs:

1) Include all functions depicted or described in the Contract Documents.

2) Include within the Control Description content:

a) All specific requirements.

b) All common requirements that pertain in general to all loops.

c) Listing all ranges, setpoints, timers, values, counter values, etc.

21. Installation recommendations:

a. Submit the manufacturer's printed recommendations for installation of instrumentation equipment.

22. Training submittals:

a. Develop and submit for review a general training plan. Include complete descriptions of all planned training classes, a preliminary training schedule, a list of all proposed instructors along with resumes, examples of proposed training manuals, and a description of any special training tools to be used (simulators, self-paced modules, personal computer-based training, etc.).

b. The ENGINEER will review the general training plan. Special emphasis will be placed on review of the qualifications of the proposed instructors and the timing of the individual courses to maximize their effectiveness. If, in the opinion of the ENGINEER, the proposed instructors are not sufficiently qualified to conduct the specified training courses, or lack experience, where required, on the specific configuration of the system, provide more qualified instructors.

c. Training course plan submittals:

1) For each training course or other training activity, submit a detailed, complete outline and agenda for each lesson.

2) Describe any student pre-requisites for the course or training activity.

3) Provide an updated schedule for all sessions of the course, including dates, times, durations, and locations.

4) Submit training materials.

d. Incorporate all submittal review comments into the course.

e. Do not conduct training courses before review and acceptance of the Course Plan submittal for the course.

23. Operation and maintenance manuals:

a. As specified in Section 01780.

b. Furnish the ENGINEER with a complete set of written operation and maintenance manuals 8 weeks before energization start-up and/or commissioning.

c. Submit preliminary sets of these manuals to the ENGINEER for review of format and content:

1) ENGINEER will return 1 set with comments.

2) Revise and/or amend as required and submit the requisite number of copies to the ENGINEER 15 days before Pre-commissioning of the systems.

d. Incorporate changes that occur during startup and submit as part of the final manuals.

e. Provide comprehensive information on all systems and components to enable operation, service, maintenance, and repair.

f. Include Record Documents and the approved shop drawing submittals, modified for conditions encountered in the field during the work.

g. Include signed results from Calibration, Loop Validation Tests, Pre-commissioning, and Performance Testing.

h. Provide installation, connection, operating, calibration, setpoints (e.g., pressure, pump control, time delays, etc.), adjustment, test, troubleshooting, maintenance, and overhaul instructions in complete detail.

i. Provide exploded or other detailed views of all instruments, assemblies, and accessory components together with complete parts lists and ordering instructions.

j. Operational Manual:

1) Prepare and provide a simplified version of the standard manufacturer’s HMI software and system operations manual that includes basic instructions in the application of the system as required for operators in day-to-day operations.

k. Spare parts list:

1) Include a priced list of recommended spare parts for all the equipment furnished under this Contract:

a) Include recommended quantities sufficient to maintain the furnished system for a period of 5 years.

2) Annotate the list to indicate which items, if any and quantity are furnished as part of this Contract.

3) Provide the name, address, and phone number of manufacturer and manufacturer's local service representative of these parts.

l. Control and SCADA System Software Record Documents:

1) Include complete documentation of all the software programs provided for the entire control and SCADA systems, including:

a) Listings of all application software on both hard copy and CD-ROM.

b) Database, both hard copy and CD-ROM.

c) Communication protocols.

d) All documentation necessary to maintain, troubleshoot, modify, or update the software system.

m. Organize the operation and maintenance manuals for each process in the following manner:

1) Section A - Process and Instrumentation Diagrams.

2) Section B - Control Descriptions.

3) Section C - Loop Drawings.

4) Section D - Instrument Summary.

5) Section E - Instrument Data Sheets and Brochures.

6) Section F - Sizing Calculations.

7) Section G - Instrumentation Installation Details.

8) Section H - Test Results.

9) Section I - Operational Manual.

10) Section J - Spare Parts List.

11) Section K - Control and SCADA System Software.

n. Provide to the Owner two sets of CDs (CDs shall contain all documents in both PDF format and unlocked AutoCAD - DWG format, version 2010 or later):

1) As-built Contract electrical and instrumentation drawings prepared for this project.

2) As-built set of all required Drawings per Section 16050 for the project.

3) As-built sets of other computer generated documents prepared for this project, including PLC ladder logic files, and Bill of Materials prepared for this project.

4) Electronic PDF version of O&M manual. Version format shall follow the hard copy submittal of the O&M, including index, equipment record sheet, warranty information, theory of operation, maintenance instruction, etc. PDF shall “bookmarked” to at each index and subtab listed in O&M.

5) These disks shall be the property of the Owner, for its use on this and future projects.

24. Testing, Calibration, and Start-up Submittal:

a. General testing submittal requirements are specified in this Section. Additional requirements are specified in Section 17950 and other Sections.

b. Test Procedure Submittals:

1) Submit the proposed procedures to be followed during tests of the PCIS and its components in two parts:

a) Preliminary Submittal: Outline of the specific proposed tests and examples of proposed forms and checklists.

b) Detailed Submittal: After successful review of the Preliminary Submittal, submit the proposed detailed test procedures, forms, and checklists. Include a statement of test objectives with the test procedures.

c. Provide certified and witnessed test and calibration checklists for each of the following tests:

1) Calibration, adjustment, and test details for all components and systems.

2) Factory Acceptance Tests.

3) Loop Validation Tests:

a) Loop Validation Certifications:

(1) After the field device loop tests have been successfully completed for all individual instruments, all separate analog control networks, all valves, all VCPs, all motors, all local operator interface panels, all motor control centers, etc., submit a certified copy of all test forms signed by the CONTRACTOR, ICSC and the OWNER's Representative, with test data entered, together with a clear and unequivocal statement that all instrumentation has been successfully calibrated, inspected, and tested.

4) Pre-commissioning Test.

5) Performance Test.

d. Factory Acceptance Test:

1) Include complete test procedures and forms to be used during the test.

25. Test reports:

a. As specified in Section 01330.

b. Additional requirements for acceptance test reports are specified in Section 17950.

26. Calculations:

    a. Where required by specific Instrumentation Specifications:

        1) Because these calculations are being provided by a registered professional engineer, they will be reviewed for form, format, and content but will not be reviewed for accuracy and calculation means.

27. Factory acceptance test:

    a. As specified in Section 01330.

    b. Additional requirements for Factory Acceptance Tests are specified in Section 17950.

28. Record documents:

    a. Furnish as specified in Section 01330.

    b. Provide record documents of all Instrumentation Drawings.

    c. Record Drawing requirements:

        1) Update Record Drawings weekly.

        2) Record Drawings must be fully updated as a condition of the monthly progress payments.

        3) Submit Record Drawings upon completion of the Work for final review.

        4) Clearly and neatly show all changes including the following:

            a) All existing pipe, conduit, wire, instruments or other structures encountered or uncovered during construction.

    d. Shop drawings:

        1) General:

            a) Coordinate all aspects of the Work so that a complete, instrumentation, computer, and control system for the facility is supported by accurate shop and record drawings:

                (1) Clearly show every wire, circuit, and terminal provided under this contract on one or more submitted wiring diagrams.

            b) Show all interfaces between any of the following: instruments, vendor control panels, motor control centers, motor starters, variable speed drives, control valves, flow meters, chemical feeders and other equipment related to the PCIS.

            c) Generate all drawings developed for this project utilizing AutoCAD 2012 or later:

                (1) Furnish on CD-ROM disks containing the following for each drawing:

(a) Original CAD files.

(b) PDF version.

(2) Provide hard copies on 11 inch by 17-inch plain bond paper.

d) Upon completion of the Work, update all shop drawings to indicate the final as-built configuration of the systems:

(1) Should an error be found in a shop drawing during installation or startup of equipment, note the correction, including any field changes found necessary, on the drawing, and submit the corrections in the Record Documents.

(2) Update, check, and revise all wiring drawings and other submitted drawings and documents to show final installed conditions.

(3) Provide as-built shop drawings for all instrumentation equipment on 11-inch by 17-inch using Bond paper.

(4) Provide electronic copies of these documents on CD-ROM disks in AutoCad 2012 and.pdf. Size all drawings to be readable and legible on 11-inch by 17-inch media.

e) Submittal Documents:

(1) Provide an interim submittal of Record Documents after the PCIS system Pre-commissioning but prior to testing.

(2) Submit final Record Documents before Substantial Completion or earlier if so specified in Section 01780 or the General Requirements.

f) Review and Corrections:

(1) Correct any Record Documents or other documents found to be incomplete, not accurate, of poor quality, or containing errors.

(2) Promptly correct and re-submit Record Documents returned for correction.

2) Furnish written information prepared specifically for this Project using Microsoft Word 2000 and pdf and printed on 8.5-inch by 11-inch plain bond paper:

a) Provide electronic copies of these documents on CD-ROM disks.

e. Review and corrections:

1) Correct any record documents or other documents found to be incomplete, not accurate, of poor quality, or containing errors.

2) Promptly correct and re-submit record documents returned for correction.

1.06 QUALITY ASSURANCE

A. Manufacture instruments at facilities certified to the quality standards of ISO 9001.

B. ICSC qualifications:

1. General:

a. It is the intent of this Division that complete responsibility in the supplying of the Switchboard/MCC/PLC, and all instrumentation in Division 17 and other equipment required for this project be supplied by one System Supplier (ICSC). This responsibility includes, but not limited to, all work necessary to select, furnish, program, supervise installation, calibrate, and place into operation all transmitters, instruments, controllers, alarm equipment, monitoring equipment, and accessories as specified herein.

b. The ICSC shall have an on staff project engineer with prior experience on similar sized projects. This project engineer shall coordinate the technical aspects of this project and prepare the submittals and drawings. The system supplier project engineer shall attend all coordination meetings and be on-site when requested by the Owner's Engineer.

c. The list of approved Control Systems Integrators who are considered by the City as qualified to program the local PLC and SCADA system is listed in Section 17100.

2. Pre-Qualified ICSC

a. The Suppliers listed below have been determined to meet minimum qualifications specified in this Division and are pre-qualified by the Owner for providing supplier bids as system suppliers on the project.

1) Krug-Bixby-Long (KBL) (phone 510 887-1117).

2) Tesco (phone 916 395-8800).

3) MCC Control Systems (formerly Meyer Controls) (phone 707 449-0341).

3. Non-Pre-Qualified ICSC

a. ICSC not pre-qualified by the Owner shall submit the information listed herein at least 14 calendar days prior to bid date, and if

approved by the Owner, will be listed in a Contract addendum prior to bid.

1) Document that the ICSC company has been actively involved in the instrumentation, PLC based control systems, and SCADA systems business for a minimum of five years and has adequate facilities, organization structure, manpower and technical and managerial expertise to properly perform the Work as specified in these Specifications.

2) Submit a financial prospectus indicative of the corporation's financial state. This prospectus shall also include:

    a) A letter from a financial institution indicating a current line of credit and bonding limit which can be applied to this Project.

    b) Latest annual report or reviewed financial statement.

3) Document that the ICSC has a qualified permanent service facility:

    a) Said facility shall be staffed with permanent employees and equipped with the tools and test equipment necessary to calibrate, test, and start-up all of the instrumentation, control, telemetry, and SCADA systems hardware and software furnished under this Contract, including remote diagnostic capability.

    b) Document in-house resource of permanent personnel experienced in the design and programming of equipment and systems as specified in these Specifications.

    c) Document the existence of a training program staffed by qualified instructors, to provide proper training in the operation and maintenance of equipment as specified in these Specifications.

    d) Document that the firm is a recognized or certified “system integrator partner” or similar designation for the SCADA software and PLC system being supplied for this Project.

    e) Service facility for the factory test shall be held within 150 miles of the project location at the ICSC company’s service facility.

4) Similar project experience of the company:

    a) Provide a list of at least 5 successfully completed projects for a water and/or wastewater system of similar scope and complexity in which the proposing firm used components the same as those intended for use on this Project. The proposing firm must have

performed, for each listed project, system engineering, system fabrication and installation, documentation (including schematic, wiring and panel assembly drawings), software configuration and documentation, field testing, calibration and start-up, operator instruction and maintenance training. In addition, provide the following information for each project:

5) Name of plant or system owner, contact name, and current telephone number. Design engineer's name, address, and telephone number. Failure to provide current contact information may result in the listed project being disqualified for use in meeting the minimum requirements for prequalification.

6) Manufacturer and model number(s) of the PLC based control system and the computer-based SCADA system used for both hardware and software.

7) Brief description of the system.

8) Approximate number of input and output signals: analog, digital, and fieldbus.

9) Brief application software description.

10) Contracted cost of the system, separate by base amount and any change orders for the completed projects.

11) Duration of the project and date of completion.

12) Information on the proposed Project team members:

    a) Provide the name and resume of the individual persons who will be responsible for each of the following:

13) Office engineering and management of this Project.

14) Lead for software configuration/programming.

15) Individual who will be responsible for the hardware and hardware interface design.

16) Individual who will be responsible for field testing, calibration, and start-up.

17) Individuals who will be responsible for operator training.

    a) All of these individuals shall be permanent employees of the proposing firm.

18) Additional information for clarification as requested by the Owner in writing shall be provided by the ICSC asking for the qualification or qualification will automatically be denied.

19) Determination of the proposed ICSC qualifications is at the sole discretion of the ENGINEER. Any qualification package deemed incomplete or lacking sufficient information to

determine qualification will result in ICSC not being qualified. No reason will be released on why an ICSC was not qualified.

C. Furnish all equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the ENGINEER and the Authority Having Jurisdiction.

D. The ICSC shall have their own operating UL listed panel fabrication facility. All panels must be fabricated at this facility and meet all UL 508/508A requirements.

E. ICSC:

1. The CONTRACTOR, through the use of a qualified ICSC, shall be responsible for the implementation of the PCIS and the integration of the PCIS with other required instrumentation and control devices.

F. System supplier responsibilities:

1. In accordance with the requirements of the Electrical Specifications.

2. System supplier:

a. Due to the critical and complex technical requirements of this Project, all Work (materials, equipment, products, submittals, labor, services, etc.) specified in the Electrical, and the Instrumentation and Control Specifications, and all Work indicated on the Electrical and Instrumentation Drawings shall be furnished by a single system supplier who has single source responsibility for both the process control and instrumentation systems and the electrical power system.

3. Contractual relationship:

a. Form a contractual relationship between the electrical subcontractor and the ICSC. ICSC may be the System Supplier.

b. Requirements for the first tier subcontractor:

1) Contract directly with the CONTRACTOR.

2) Be either the electrical subcontractor or the ICSC.

c. Requirements for the second tier subcontractor:

1) A division of the first tier subcontractor, or

2) A joint venture with the first tier subcontractor, or

3) A subcontractor to the first tier subcontractor.

d. The system supplier manages, directs, and supervises all of the Work of its second tier subcontractor. The system supplier is solely responsible for the entire electrical and instrumentation system including, but not limited to, all Electrical, Instrumentation, and Process Contract Drawings, the Instrumentation and Control and the Electrical Specifications:

1) Provide any additional conduit, wire, etc.

2) Any additional I/O, programming, screens, interface devices needed by the system supplier are to be provided by the electrical subcontractor or the ICSC, under the above outlined working agreement.

3) Ensure compatibility between the PCIS system and the electrical system being installed.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store all equipment and materials delivered to the job site in a location that will not interfere with the construction or the OWNER's operations.

B. Shipping precautions:

1. After completion of shop assembly, successful FAT, pack all equipment, cabinets, panels, and consoles in protective crates and enclose in heavy-duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.

2. Place dehumidifiers when required, inside the polyethylene coverings.

3. Skid-mount the equipment for final transport.

4. Provide lifting rings for moving without removing protective covering.

5. Display boxed weight on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

C. Special instructions:

1. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.

2. The CONTRACTOR shall ship the PCIS equipment listed below to PROGRAMMER's office in within 90 days after Notice to Proceed is issued to the CONTRACTOR:

a. PLCs to be programmed by PROGRAMMER, including all chassis, power supplies, CPUs, IO modules, cables, and related equipment.

b. All network communications equipment and cables less than 10 feet in length.

c. Any personal computers.

3. Equipment provided to Programmer be limited to a Development Station, and the components include each type of PLC hardware (software and Modbus smart devices, as well as the supporting devices already listed. The specified laptops and software should also be included to facilitate downloading programming in the field. The project PLC's should remain with the ICSC and be mounted in the PLC Panels once installed, powered, and field conditions are suitable. The CONTRACTOR shall allow time in the Project Schedule for this 150-day requirement. The CONTRACTOR is responsible to obtain necessary submittal reviews, order equipment, and allow sufficient delivery time to comply with this requirement. No schedule extension shall be allowed due to failure of the CONTRACTOR to comply with these requirements.

4. The CONTRACTOR shall also supply, for the use of the PROGRAMMER, samples of any devices or equipment that will communicate to the PROGRAMMER-programmed PLCs using Modbus, Modbus plus, Ethernet, or any other digital network. These samples must be shipped to the PROGRAMMER's facility and remain there for a minimum of 90 days prior to the PLC panel factory tests.

5. The CONTRACTOR shall be responsible for shipping the above equipment from the PROGRAMMER's facility. At the designated time for shipment of the above equipment to the factory test site or the field (whichever applies), the CONTRACTOR shall send personnel to the PROGRAMMER's office to package and ship the equipment to the factory test site. The CONTRACTOR shall have sole responsibility to package and ship the equipment, including packing materials and shipping charges. Prior to packaging and shipping, the CONTRACTOR shall examine and test all equipment, as needed, and shall certify, in writing, that the equipment appears to be in proper working order, and shall deliver the certification to the PROGRAMMER, who shall forward copies to the OWNER and ENGINEER.

D. Tagging:

1. Tag each component and/or instrument to identify its location, instrument tag number, and function in the system.

2. Firmly attach a permanent tag indelibly machine marked with the instrument tag number, as given in the tabulation, on each piece of equipment constituting the PCIS.

3. Tag instruments immediately upon receipt in the field.

4. Prominently display identification on the outside of the package.

5. Utilize the Tag and Loop Number identifications shown on the P&IDs.

E. Delivery and inspection:

1. Deliver products in undamaged condition, in manufacturer's original container or packaging with identifying labels intact and legible. Include date of manufacture on label.

1.08 PROJECT OR SITE CONDITIONS

A. Site conditions:

1. Provide a PCIS, including all equipment, raceways and any other components required for a complete installation that meets the environmental conditions for the Site as specified in the General Requirements and below.

2. Seismic classification:

a. Provide all equipment and construction techniques suitable for the seismic requirements for the site, as specified in Section 01900.

3. Wind:

a. Provide all equipment and construction techniques suitable for the site wind loading criteria, as specified in Design Criteria shown on Contract Drawing GS01.

4. Altitude, temperature and humidity:

a. As specified in the Section XXXXX.

b. Provide all equipment and instrumentation fully rated for continuous operation at this altitude, temperature and humidity conditions with no additional derating factors applied.

c. Provide additional temperature conditioning equipment to maintain all equipment and instrumentation in non-conditioned spaces or outdoors subject to these ambient temperatures 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature as determined by the equipment manufacturer's guidelines:

1) Provide all power wiring for these devices (e.g., heaters, fans, etc.), whether or not indicated on the Drawings.

5. Area classifications:

a. Furnish enclosures that match the area classifications as specified in Section 16050.

6. Site security:

a. Abide by all security and safety rules concerning the Work on the Site, as specified in Section 01500.

1.09 SEQUENCING

A. General:

1. As specified in Section 01312.

2. Testing requirements are specified in Section 17950 and other sections.

3. General scheduling requirements are specified in Section 01320.

4. Work restrictions and other scheduling requirements are specified in Section 01140.

5. As specified in Section 01750.

6. All dates for witness testing shall be on those agreed to by the City and Engineer. Request for scheduled witness testing shall be made by the Contractor in writing in the time line noted herein.

B. Submit proposed ICSC statement of qualifications:

1. The ICSC must be approved by the ENGINEER before any other Work commences.

C. Pre-submittal conferences:

1. Before producing any submittals, schedule a pre-submittal conference for the purposes of reviewing the entire project, equipment, control philosophy, schedules, and submittal requirements.

2. The CONTRACTOR, instrumentation and control subcontractor, electrical subcontractor, and all manufacturers furnishing major pieces of equipment must attend, including but not limited to:

   a. Vendor control panels.

   b. Chemical feed systems.

   c. Motor control centers.

   d. Switchboard.

   e. Variable frequency drives.

   f. Lighting.

   g. Engine generators. (Where shown)

3. The PROGRAMMER shall be invited to attend the pre-submittal conference.

D. System configuration meetings:

1. Attend meetings to coordinate the SCADA system configuration, the system database, control schemes, displays, etc., with the PROGRAMMER, ENGINEER and OWNER on at least three occasions during development.

2. Preliminary meeting: Meet before configuration work is begun on any PLCs programmed by the CONTRACTOR (including those provided through subcontractors and suppliers). CONTRACTOR shall provide a list of each PLC and other programmable devices that will interface to the rest of the SCADA system, including make, model, and a description of the interface; provide contact information for each individual responsible for programming each said PLC and device; and provide a listing of the submittals that will contain SCADA interface information with a schedule for when each submittal will be provided.

3. Intermediate review meeting: Held after approximately one-half of the interface submittals identified in the Pre-submittal Conferences paragraph above have been submitted. Individuals responsible for programming PLCs and other programmable devices supplied by CONTRACTOR shall attend this meeting. Meet to discuss SCADA interface submittals and requirements.

4. Final review meeting: Held after all SCADA interface submittals have been submitted. Meet to discuss SCADA interface submittals and requirements.

5. Additional requirements as specified in Sections 17100, and 17761. Individuals responsible for programming PLCs and other programmable devices supplied by CONTRACTOR shall attend this meeting by telephone conference call.

E. FAT:

1. Before the delivery and installation of control panels, PLCs, SCADA equipment, and other PCIS components at the job site, but after the procurement and assembly of components, perform FAT testing.

2. Schedule the FAT after receiving approval of the FAT procedures submittal.

3. Submit a copy of the factory test procedures including all forms at least 21 days before any scheduled test date.

4. Notify the ENGINEER of scheduled tests a minimum of 15 days before the date of the test.

5. As Specified in 17950.

F. Loop validation test.

1. Notify the ENGINEER of scheduled tests a minimum of 30 days before the estimated completion date of installation and wiring of the PCIS.

2. Complete loop validation testing a minimum of 5 days before the pre-commissioning phase of the project.

3. Loop validation certifications:

a. After the field device loop tests have been successfully completed as specified in Section 17950 for all individual instruments, all separate analog control networks, all valves, all VCPs, all motors, all local operator interface panels, all motor control centers, etc., submit a certified copy of all test forms signed by the CONTRACTOR, ICSC, and the OWNER's representative with test data entered, together with a clear and unequivocal statement that all instrumentation, including all control and signal wiring, has been successfully calibrated, inspected, and tested.

G. Training:

1. As specified in Section 01750.

2. Complete all training before the pre-commissioning phase of the project may start.

3. Schedule the training sessions a minimum of 21 days before the start date of the courses.

4. Submit training manuals to the ENGINEER a minimum of 10 days before starting the training session.

5. Within 10 days after the completion of each session, submit the following:

a. A list of all OWNER personnel that attended the session.

b. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.

H. Pre-commissioning test:

1. Commence after acceptance of all training, wire test, calibration tests, and loop validation tests, and all inspections have demonstrated that the PCIS complies with all Contract requirements.

2. Acceptance of the PCIS pre-commissioning testing must be provided in writing by the ENGINEER before the performance testing may begin.

3. The PROGRAMMER shall assist with pre-commissioning testing for PLCs programmed by the PROGRAMMER, as specified in Section 17950.

4. The PROGRAMMER shall not be required to be on site, nor shall the PROGRAMMER be required to supply application software, until the loop validation tests are complete for a PLC and all prerequisites for the pre-commissioning test are completed.

I. Provide all special tools and spare parts, as specified in the Maintenance paragraph of this Section, before performance testing commences, suitably wrapped and identified.

J. Performance testing:

1. Complete pre-commissioning test a minimum of 5 days before the performance test.

K. Substantial completion: The following conditions be fulfilled before the PCIS is considered complete:

1. All submittals have been completed and approved.

2. The PCIS has been calibrated, loop tested and pre-commissioned.

3. The OWNER training has been performed.

4. All required spare parts, expendable supplies, and test equipment have been delivered to the OWNER.

5. The performance test has been successfully completed.

6. All debris associated with installation of instrumentation has been removed.

7. All probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.10 WARRANTY

A. Warrant the PCIS as specified in Section 01781:

1. Provide additional warranty as specified in the individual Instrumentation and Control Specifications.

1.11 SYSTEM START-UP

A. Replace or modify equipment, software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:

1. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the ENGINEER.

1.12 MAINTENANCE

A. Before Substantial Completion, perform all maintenance activities required by the Contract Documents including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.

B. Furnish all spare parts as required by the Contract Documents.

C. Include in the Bid a $10,000.00 tools and spare parts allowance:

1. Furnish the spare parts selected by the ENGINEER from the priced list of spare parts in the hardware submittal.

2. Furnish a price list of all special tools required to calibrate and maintain all of the instrumentation provided under the Contract Documents. Furnish the special tools selected by the ENGINEER from the priced list.

3. The OWNER at its discretion may elect to remove any or all of this allowance from the Contract, credit any amounts so removed to the OWNER with a reduction in the Contract Price.

D. In addition to the tool and spare parts allowance furnish the following:

1. One portable instrument calibrator current simulator with charger, pressure modules to accommodate all pressure measuring instruments furnished, and carrying case:

a. Rochester Instrument Systems (RIS) CL-9002.

b. Fluke 702 DPC.

c. Transmation.

E. Provide additional spare parts specified in other sections of the Instrumentation and Control Specifications.

F. Submit all special tools and spare parts, suitably wrapped and identified, before performance testing commences.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Provide similar items from a single manufacturer throughout the PCIS portion of the Project.

B. Allowable manufacturers are specified in individual instrument and equipment specifications in other sections of the Instrumentation and Control Specifications.

2.02 MATERIALS

A. Furnish all materials under this Contract that are new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these devices and that bear all approvals and labels as required by the Specifications.

B. Provide materials complying with the applicable industrial standard as specified in the Contract Documents.

2.03 COMPONENTS

A. Furnish all meters, instruments, and other components that are the most recent field proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise specified to match existing equipment.

B. Unless otherwise specified, furnish individual instruments that have a minimum accuracy of ±0.5 percent of full scale and a minimum repeatability of ±0.25 percent of full scale.

C. Signal transmission:

1. Analog signals:

a. Furnish analog measurements and control signals that vary in direct linear proportion to the measured variable, unless otherwise indicated.

b. Furnish electrical analog signals outside control panels that are 4 to 20 milliamperes 24 VDC, except as indicated.

c. Analog signals within enclosures may be 1 to 5 VDC.

d. Electrically or optically isolate all analog signals from other signals.

e. Furnish regulated analog signals that are not affected by changes in supply voltage or load resistance within the unit's rating.

f. Maintain the total 4 to 20 milliamperes loop impedance to 10 percent below the published value at the loop operating voltage.

g. Where necessary, reduce loop impedance by providing current-to-current (I/I) isolation amplifiers for signal re-transmission.

2. All pneumatic signals: 3 to 15 pounds per square inch gauge.

3. Discrete input signal as indicated in the controller hardware specification.

4. Discrete output signals:

a. Dry contacts or TRIAC outputs (with express written approval by the ENGINEER) as needed to coordinate with the field device.

b. Provide external terminal block mounted fuse with blown fuse indication for all discrete outputs.

c. Provide interposing relays for all discrete outputs.

D. Discrete circuit configuration:

1. Configure discrete control circuits to fail safe, on loss of continuity or loss of power.

2. Alarm contacts: Fail to the alarm condition.

3. Control contacts fail to the inoperative condition unless otherwise indicated on the Drawings.

E. Grounding:

1. Provide control panels with a signal ground bus, isolated from the power ground bus:

a. Provide multiple panels in one location with a common point for signal ground bus connection to ground.

2. Ground single point ground shields and measurement loops at the source panel external terminals, unless otherwise noted, by bonding to the control panel signal ground bus.

3. Provide isolating amplifiers within control panels for field equipment possessing a grounded input or output, except when the panel circuit is galvanically isolated.

F. Instrument air:

1. Provide dry, filtered control air at 30 pounds per square inch gauge nominal pressure piped to all field instruments and instrument panels requiring air:

a. Provide each field instrument with an integral, non-adjustable filter/regulator assembly to provide regulated air.

b. Provide each instrument panel requiring air with an adjustable filter/regulator assembly with gauge and an air manifold to provide air to pneumatic instruments.

c. Filter all air to 5 micron maximum particle size.

d. Provide low pressure switch to alarm on insufficient air supply.

2.04 ACCESSORIES

A. Provide flow conditioning devices or other required accessories if necessary to meet the accuracy requirements in the Contract Documents.

2.05 SOURCE QUALITY CONTROL

A. Provide all equipment that is new, free from defects, and standard products produced by manufacturers regularly engaged in the production of these products that bear all approvals and labels as required by the Specifications.

B. Arrange with all manufacturers of the equipment and fabricators of panels and cabinets, to allow the OWNER and ENGINEER to inspect and witness the testing of the equipment at the site of fabrication:

1. Equipment includes the cabinets, special control systems, flow measuring devices, and other pertinent systems and devices.

C. Factory testing is specified in Section 17950 and other sections of the Electrical, and the Instrumentation and Control Specifications.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The ICSC is encouraged to visit the site and attend a pre-bid conference and examine the premises completely before bidding. It is the ICSC's responsibility to be fully familiar with the existing conditions and local requirements and regulations.

B. Review the existing Site conditions and examine all shop drawings for the various items of equipment in order to determine exact routing and final terminations for all wiring and cables.

C. Provide a complete instrumentation and control system:

1. Install all extra conduits, cables, and interfaces as may be necessary to provide a complete and operating electrical, and process control and instrumentation system.

3.02 INSTALLATION

A. Equipment locations indicated on the Drawings may change due to variations in equipment size or minor changes made by others during construction:

1. Verify all dimensions as indicated on the Drawings:

   a. Actual field conditions govern all final installed locations, distances, and levels.

2. Review all information indicated on the Drawings, including architectural, structural, mechanical, instrumentation, and the accepted electrical, instrumentation, and mechanical shop drawings, and coordinate Work as necessary to adjust to all conditions that arise due to such changes.

3. Make minor changes in location of equipment before rough in, as directed by the OWNER or ENGINEER.

B. Perform all related Electrical Work in accordance with the applicable sections of the Electrical Specifications.

C. The PCIS configurations are diagrammatic:

1. The locations of equipment are approximate unless dimensioned.

2. Where Project conditions require, make reasonable changes in locations and arrangements.

D. Field instruments installation:

1. Install field instruments as specified in the Contract Documents, ANSI/API 550 and 551, and the manufacturer's instructions.

2. Mount field instruments so that they can be easily read, readily approached, and easily serviced, and so they do not restrict access to mechanical equipment:

   a. Mount field instruments on a pipe stand or local panel, if they are not directly mounted, unless otherwise indicated on the Drawings.

   b. Provide sun shields for all field electronic instruments exposed to direct sunlight.

3. Make connections from rigid conduit systems to field instruments with PVC coated flexible conduit:

   a. Type of flexible conduit required for the area classification:

      1) Area classification as specified in Section 16050.

   b. Maximum length of 18 inches.

4. Connect field instruments with cable as specified in the Electrical Specifications, except when the manufacturer requires the use of special cable, or otherwise specified in this Section:

   a. Special cable applications shall be in accordance with the NEC.

5. Verify the correctness of each installation:

   a. Polarity of electric power and signal connections.

   b. Ensure all process connections are free of leaks.

6. Provide a power disconnect switch for each 120 VAC powered instrument which does not have a built-in power disconnect:

   a. Disconnect enclosure suitable for the area classification:

      1) As specified in Section 16050.

E. Process sensing lines and air tubing:

1. Install individual tubes parallel and/or perpendicular to and near the surfaces from which they are supported.

2. Provide supports for rigid tubing at intervals of not more than 3 feet.

3. Slope horizontal runs of instrument tubing at a minimum of 1/16th inch per foot to allow for draining of any condensate.

4. Bends:

   a. Use proper tool.

   b. Make bends for parallel lines symmetrical.

   c. Make bends without deforming or thinning the walls of the tubing.

5. Square-cut and clean all ends of tubing before being inserted in the fittings.

6. Provide bulkhead fittings at all panels requiring pipe and/or tubing entries.

7. Use stainless steel tubing for all piping hard piped from the air header, unless otherwise indicated on the Drawings or not compatible with the fluids or atmosphere in the area:

   a. Use flexible connections only on moving equipment and under the constraint that the length shall be less than 1.5 times maximum travel of the equipment.

F. Conduit, cables, and field wiring:

1. Provide all PCIS equipment cables, and process LAN communication networks under the Instrumentation and Control Specifications.

2. Provide terminations and wire identification as specified in the Electrical Specifications.

3. Protect all wiring from sharp edges and corners.

4. Provide all conduits, fittings, boxes, etc. in accordance with all the requirements of the Electrical Specifications.

G. Equipment tie-downs:

1. Anchor all instruments, control panels, and equipment by methods that comply with seismic and wind bracing requirements, which apply to the Site.

2. All control panels, VCPs, LCPs, RTUs, PCMs, etc., shall be permanently mounted and tied down to structures.

H. Instrument tagging:

1. As specified in Section 16075.

2. Provide all field-mounted instruments with nameplates:

a. Nameplates engraved with the instrument's full tag number as indicated on the Drawings:

1) Affix tags with stainless steel wire fasteners.

3. Provide all back of panel instruments with nameplates:

a. Engraved with the instrument's full tag number as indicated on the Drawings:

4. Provide all front of panel instruments with a nameplate:

a. Engraving to include the instrument's full tag number and service description.

b. Secure nameplates to the panel with stainless steel screws.

c. Use an approved adhesive if screws would violate the NEMA or other ratings of the enclosure.

I. Cable and conductor termination:

1. Terminate all cables and conductors on terminal blocks.

2. Terminal block enclosures:

a. Suitable for the area classification as specified in Section 16050.

J. Surge protection:

1. Provide outdoor field instrument loops with voltage surge protection units installed on the instruments.

2. Individually fuse each 4-20 milliamperes direct current loop with a 1/16 ampere fuse between power supplies and receiver surge protectors.

3. Provide voltage surge protection for 4 wire transmitters and analyzers:

a. Protect both power source and signal loop.

3.03 FIELD QUALITY CONTROL

A. Inspection:

1. Allow for inspection of PCIS installation as specified in Section 01410.

2. Provide any assistance necessary to support inspection activities.

3. ENGINEER inspections may include, but are not limited to, the following:

a. Inspect equipment and materials for physical damage.

b. Inspect installation for compliance with Drawings and Specifications.

c. Inspect installation for obstructions and adequate clearances around equipment.

d. Inspect equipment installation for proper leveling, alignment, anchorage, and assembly.

e. Inspect equipment nameplate data to verify compliance with design requirements.

f. Inspect cable terminations.

g. Inspect/witness instrument calibrations/verifications.

4. Inspection activities conducted during construction do not satisfy inspection requirements specified in Section 17950.

B. Field testing is specified in Section 17950. Additional general requirements are specified in Section 01750.

C. Installation supervision:

1. Ensure that the entire PCIS is installed in a proper and satisfactory manner. At a minimum, the ICSC shall provide the following services:

a. Installation resources:

1) Coordinate with the CONTRACTOR regarding installation requirements of the Contract Documents.

b. Provide technical assistance to installation personnel by telephone:

1) Furnish installation personnel with at least one copy of the approved submittals, including all installation details.

c. Periodic inspections during the construction period.

d. A complete check of the completed installation to ensure that it is in conformance with the requirements of the equipment manufacturer and the Contract Documents.

e. Field verify accuracy and calibration of all instruments.

3.04 ADJUSTING

A. Control valves:

1. Stroke all control valves, cylinders, drives and connecting linkages from the control system as well as local control devices and adjust to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position.

2. Check control valve actions and positioner settings with the valves in place to ensure that no changes have occurred since the bench calibration.

B. Adjust settings of float and pressure switches during performance testing, start-up and during the warranty period as directed by Owner to protect equipment.

C. Make all revisions necessary to the control system software, as directed by the ENGINEER. It is understood that the CONTRACTOR knows and agrees that changes will be required in the control system software during the factory acceptance tests, the pre-commissioning, performance testing, start-up and during the warranty period.

3.05 CLEANING

A. As specified in Section 01770.

B. Remove all foreign material and restore all damaged finishes to the satisfaction of the ENGINEER and OWNER.

C. Vacuum and clean all control panels and enclosures before start-up and again after final completion of the project.

D. Clean all panel surfaces.

E. Return to new condition any scratches and/or defects.

F. Wipe all instrument faces and enclosures clean.

G. Leave wiring in panels, manholes, boxes, and other locations in a neat, clean, and organized manner:

1. Neatly coil and label all spare wiring lengths.

2. Shorten, re-terminate, and re-label excessive spare wire and cable lengths, as determined by the ENGINEER.

3. Remove all foreign debris after final completion of project.

H. As specified in other sections of the Contract Documents.

I. Use of compressors or air blowers for cleaning is not acceptable.

J. Remove all decals and lettering from both sides of support plates.

K. Repair damage to factory finishes with repair products recommended by Manufacturer.

3.06 DEMONSTRATION AND TRAINING

A. Demonstration requirements are specified in Section 17950.

B. Training:

1. General:

a. Provide system maintenance and operator training courses for all the instrumentation and control equipment and systems furnished, as described below. All training described below shall be provided by the CONTRACTOR. The PROGRAMMER is not responsible for the training described in this Section. The PROGRAMMER will provide training on software provided by the PROGRAMMER.

b. Conduct all training at the Project Site unless another location is approved by the ENGINEER and OWNER:

1) Include instruction on the use of all maintenance equipment and special tools provided under the Contract.

c. Tailor training classes to the specific needs of the class participants:

1) Develop separate courses for operators, maintenance staff, and supervisors:

a) The specific categories and number of personnel in each category are identified below.

2) Furnish training courses that are a combination of classroom and hands-on training:

a) Limit classes that include extensive hands-on activities to a maximum of 5 students per class.

3) Present the minimum number of sessions, specified in Table 17050-3.10-T1, for each course in order to satisfy class size restrictions and limitations scheduling OWNER staff.

4) Furnish additional sessions if required to accommodate the total number of personnel identified for each course.

d. Schedule individual training classes with the OWNER at least 3 weeks before the start of the class:

1) Schedule all training classes Monday through Thursday, between 7:30am and 3:30pm.

2) Each individual daily training session, travel time excluded:

a) Minimum duration of 4 hours.

b) Maximum duration of 7 hours.

c) Breaks scheduled at least every 90 minutes and 1 hour for lunch.

3) Complete training for maintenance personnel 90 days before performance testing.

4) Complete operator training classes before start-up of the SCADA system, or any part of it:

a) As specified in the Sequencing article of this Section.

5) Schedule follow-up training classes after SCADA start-up on a schedule determined by the OWNER.

e. Furnish highly qualified training instructors for technical training with demonstrated expertise in not only control system functionality but also professional training techniques:

1) Instructors are subject to the approval of the ENGINEER.

2. Training manuals and materials:

a. Furnish training manuals and other materials for training courses.

b. Manuals are to be professionally written to present the course material in a format that is easy to comprehend.

c. The manuals are to serve as teaching aids during presentation of the training classes.

Manuals are to serve as reference material after the training has been completed.

Table 17050-3.10-T1			
Course Title	**Minimum Course Length (days per session)**	**Personnel (Estimated Number of Students)**	**Minimum Number of Sessions**
System Overview	1	10	2
Operator Training - Basic	3	10	6
Operator Training - Advanced	2	5	4
CIS (Computer) Equipment Maintenance	2	4	4
OIT Software	5	3	10
PLC Hardware	2	4	4
PLC Software	4	6	8
HMI Hardware and Software	2	5	4
Network Equipment	2	4	4
Follow-up Training	1	5	2
Instrument Training	3	3	6

3. Training course requirements:

   a. System overview training:

      1) Furnish a training course that gives the OWNER's supervisory level personnel an overview of the new CONTRACTOR-provided elements of the PCIS system. Focus on the overall functional aspects of each new elements of the control system, particularly the mechanical system vendor-provided control packages.

   b. Operator training:

      1) Furnish training courses that instruct system operators in the efficient operation of CONTRACTOR-provided aspects of the PCIS that include not only the general operation of each control system but also the operation of specific system features.

      2) Operator's training shall include the following for each vendor package and programmable device:

         a) Control system overview: Architecture, equipment functions, software components, etc.

         b) Display navigation, overview, and types of displays.

         c) Process and equipment monitoring and control: Basic principles and operation.

         d) Logging ON and OFF the system and description of the security and access system.

         e) Alarm subsystem.

f) Trending: Provide a thorough session on how to use all trending functions.

g) Reports: How to access, print, and review content.

h) Control strategies: Present an average 15-minute review of each control strategy, including a hands-on demonstration of screens and operator functions for each.

c. PLC hardware training:

1) Furnish training on PLC hardware and on related components, including battery backup equipment, UPSs, HMI hardware, control circuits, and analog circuits.

2) Furnish training on PLC hardware principles, product features, proper installation, operation, troubleshooting, and maintenance.

3) PLC training may be provided by manufacturer's certified trainers.

d. PLC software training:

1) Furnish training on PLC software.

2) Two types of training are required, basic and project-specific:

a) Basic PLC software training covers the principles of PLC programming and the specific features and function of the PLC products used on this Project, provided by one of the PLC manufacturer's certified trainers.

b) Project-specific PLC software training covers the programming conventions, new standardized software modules, specific control strategy programs, and documentation created for the Work performed under this Contract. This training includes the specific knowledge needed to modify, expand, duplicate, troubleshoot, and repair the PLC programs provided under this Contract, provided by a qualified who is thoroughly familiar with the delivered system, and is one of the senior programmers who programmed the PLCs for this Project.

e. HMI hardware and software training:

1) Provide the following:

a) Overview of hardware and firmware, including starting, stopping, and PLC interface.

b) Configuration of tag database.

c) Creating, editing, and saving display screens.

d) Troubleshooting.

f. Network equipment training:

1) Furnish basic training on all network hardware, switch and router configuration and software, and network monitoring software.

2) Include a detailed description and explanation of the installed network architecture, media, and functions.

3) Furnish an overview of the function and operation of each piece of network equipment.

4) Furnish training on network maintenance troubleshooting and repair.

5) Furnish training on how to install spare or off-line backup equipment.

g. Follow-up training:

1) Provide a series of on-site follow-up training classes beginning after start-up of the SCADA/PCIS system. The intent for these classes is to provide the OWNER's personnel the opportunity for a review and "refresher" of the training topics and material after they have had some experience using the system.

2) Mutually schedule and develop the content of these classes with the OWNER no later than 1 month before the beginning of the first session:

a) Schedule at the OWNER's discretion on non-consecutive days spaced out over the start-up and warranty period.

h. Instrumentation training:

1) Furnish training covering all instruments and control panels.

2) Furnish the specified quantity of training, allocated to cover new instruments and hardwired controls as described in this Section and specifically determined in the approved training plan.

3) Train maintenance staff in the use, cleaning, calibration, maintenance, and troubleshooting of all the instruments furnished within this Project.

4) Furnish training on the operation of new hardwired controls.

4. Recording training sessions:

a. Record all training.

b. Provide pre-recorded audio-visual presentations. Produce audio-visual presentations by recording the actual training sessions of the OWNER'S personnel.

c. Furnish digital video disk (DVD) format.

d. These disks become the property of the OWNER and cover, in detail, the training for the specific hardware and software of all the systems provided for the Project.

e. Provide all the necessary cameras and recording equipment.

3.07 PROTECTION

A. Protect all Work from damage or degradation until date of Substantial Completion.

END OF SECTION

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SECTION 17100

CONTROL STRATEGIES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Contractor-developed loop description submittal requirements.
2. General programming requirements.
3. Common control functions:
   a. General control and monitoring functions to be provided throughout the PCIS system.
   b. These requirements apply to all systems, and supplement the specific loop descriptions in Section 17101 and information indicated on the Drawings.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
   b. Section 17101 – Shasta Park Water Facility Specific Control Strategies.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

B. Hardwired control: Control circuitry that does not utilize software to initiate functionality.

C. Hardwired interlocks: A safety or protective feature that will interrupt operation of the equipment in all operating modes with no required operator intervention.

D. Software interlocks: A safety or protective feature that will interrupt operation of the equipment when the PLC has control.

E. Slew rate: Rate of change in respect to time.

F. Clamp: Imposed upper and lower limits on setpoints to eliminate entries outside the allowable control parameters.

G. Watch dog timer: Timers imposed to test components such as discrete I/O to verify the health of the I/O card.

1.04 SUBMITTALS

A. As specified in Section 17050.

1.05 WARRANTY

A. As specified in Section 17050.

1.06 QUALITY ASSURANCE

A. Contractor shall retain the services of a Control Systems Integrator for programming the local PLC and interfacing with the City of Sacramento-Department of Utilities (City) Supervisory Control and Data Acquisition (SCADA) system, and for providing testing and startup for the Shasta Water Facilities (Shasta). The Contractor shall ensure the Work performed by the Control systems Integrator meets the requirements of the Contract documents, including all approved Change Orders. Control Systems Integrator retained by the Contractor for performing the Work described in this change Order shall be one of the following city approved system integrators:

1. KBL (Krug Bixby Long) Associates
2. Saber Engineering
3. Tesco Controls, Inc.
4. Volo Technologies
5. Westin Engineering, Inc.

B. Programming shall be performed on site at 1395 35th Avenue, Sacramento, CA between 7:00 AM and 3:30 PM weekdays on city furnished work space, computer and application programs; Schneider Unity pro XL for the PLC and VTS Trihedral for SCADA.

C. Programming for Shasta shall be furnished by the System Integrator, using City provided templates for programming.

D. Programming by the Control Systems Integrator shall allow for function and interaction with the City SCADA System utilizing VTS Trihedral application program. Screens shall match the existing VTS Trihedral programming conventions of color and Operator interface for other similar City facilities.

1. Create database tags per City Standard naming conventions
2. Create typical “OVERVIEW” screens similar to City standards
   a. Create pop for DI, DO AI, HOA and Configure
3. Create typical “ALARM INDEX” screen

E. Develop programming of the Station PLC with interface functions to the SADA system as shown on the Contract documents, as described herein and as directed

by the City to allow local remote/off/hand and HMI auto/off/hand operation of Shasta pumps, motors and auxiliary equipment.

1. Station PLC programming includes Shasta pumps& motors, switchboard relays, and power meters, level transducers and switches, gas analyzers, flowmeters and other instruments and shown on the PLC I/O Schedule and P&ID drawings, and as coordinated by the Contractor.
2. Develop programming of the Station PLC to allow interaction with interlocks as shown on the Contract documents, as described herein, and as directed by the city.

F. Coordination Meetings:
   1. City Coordination Meetings: Minimum of three separate 4-hour meetings at City DOU located at 1395 35th Avenue, Sacramento, CA as described in Section 17050.
   2. Contractor Coordination Meetings: as required.

G. Submittal Requirements:
   1. Requirements per Section 01330 – Submittals and Section 17050 – Common Work Results for Process Control and Instrumentation Systems.
   2. Description of program functions, values, and variables
   3. Preliminary screen operator interface panel displays and HMI screen displays, in color.

H. Testing and Startup:
   1. Perform Preoperational and Operation Testing per Section 17950 – Testing, Calibration and Commissioning
   2. Preoperational Testing shall include: field to PLC point-to-point verification via local HMI, verification of communications from PLC to Regional, and point-to-point verification from field to City SCADA.
   3. Operational testing shall verify all control and monitoring points from and to SCADA and the Station PLC, local and remote HMI, and local controls.
   4. Prior to testing, submit Testing and Startup Plan including testing objectives, forms and checklists for review and approval.
   5. Perform testing and startup per the approved Testing and Startup Plan
   6. Submit certified test forms and checklists upon successful completion of testing.
   7. Testing shall be witnessed by Engineer and City Operations, Electrical, Instrumentation and SCADA Staff.

I. Programming for the operation of Shasta shall be according to the control narrative in Section 17101 and Contract Documents.

J. City can provide typical screen shots of a Trihedral screen and HMI screen.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

A. As specified in Section 17050.

B. General programming requirements:

1. Use variable names or aliases derived from tag and loop identification on the P&IDs for all process values.

2. Store all adjustable parameters in the PLC, and configure so that an operator with sufficient security access can change the parameters from the HMI or OIT. Update and display the current value at all locations, regardless of where the last change was made.

3. Program slew rates for all setpoints to limit the effect of updated setpoints on the process:

   a. Provide for control setpoints and manual speed and position selections.

   b. Store new setpoints in one register, and gradually ramp the actual setpoint register at the slew rate until it reaches the new value.

   c. Provide operator access to change slew rates from the OIT.

4. Saved setpoints:

   a. Provide an operator selection to save all setpoint values.

   b. Furnish one or more screens at the OIT that display the initial values for all setpoints defined during startup, and the value for each setpoint the last time they were saved.

   c. Provide an operator selection to restore all setpoints to the initial startup value.

   d. Provide an operator selection to restore all setpoints to the last saved value.

5. Store a copy of all adjustable parameters and accumulated and integrated totals in SCADA:

   a. Upon re-loading of the PLC program, re-load these values to the PLC from SCADA.

6. Calculated values:

   a. Program calculations such that division by zero errors cannot occur.

   b. Prevent calculations from generating values that exceed the limits of the equipment or data type structures (integers) internal to the PLC.

   c. Configure counting functions (start counts and operation counts) to allow a minimum of 10,000 counts, and to roll-over to zero at an even decimal interval (1 followed by 4 or more zeros).

   d. Configure integrating functions to accumulate the maximum rate from the instrument for 1 year. Ensure that each incremental addition can be added while maintaining 2 significant digits of the incremental value at all times up to the reset value or 11 percent above the alarm value. Configure the integrated value to roll over to zero at an even decimal interval greater than 1 year's

accumulation at full rate, or generate a reset alarm when the accumulated value reaches 90 percent of the maximum value that will allow accurate accumulation.

7. Timers:

   a. Provide programmable settling and proving timers in all control sequences for starting and stopping of equipment to allow the process to settle down before proceeding with any additional control functions.

   b. Provide programmable backspin timers in all control sequences for starting and stopping of pumps to allow the pump to stop spinning before allowing it to restart.

   c. Embed the timers in the PLC logic, tune in the field, and list separately as part of the software submittal and O&M manual.

8. PCM status:

   a. Furnish a minimum of 1 screen that depicts the status of all enclosures containing PLCs or I/O in the control system, including but not limited to the following:

      1) Intrusion status on all enclosures equipped with intrusion switches.

      2) AC power failure:

         a) Monitor ahead of UPS.

      3) DC power supply failure:

         a) For redundant power supplies, alarm when either power supply fails.

      4) UPS failure signal.

9. PLC system communication status:

   a. Furnish a minimum of 1 screen to display all communication errors and status within the PCIS:

      1) Communication between SCADA and PLCs, PLC to PLC, PLC to RIO.

      2) Display status of each node, and summary of failures over the past 60 minutes.

   b. Generate a communications alarm if any communication fault is detected or there is no response from a node for more than a user specified time.

   c. In the event of communications loss:

      1) Continue normal operation at each PLC.

      2) Where control parameters are received over a communications link:

         a) If a link fails where process elements use the remote value for closed-loop control, hold operating

status, speed and position, of the process elements at their last state before the communication alarm, unless other I/O local to that PLC indicates shutdown or over-ride conditions:

3) Ensure that the operator can control the process using PCIS HAND mode at the local HMI.

a) If a link fails where process elements use the remote value to determine setpoints, settings or control levels, continue to operate using the last value received:

(1) Provide a manual over-ride entry at the local HMI to allow an operator to enter a different value for any such remote signal.

(2) Generate an alarm whenever an over-ride value is in use.

10. “Ready for Pump” Status:

a. Provide a “Ready for Pump” status indicator next to pump graphic. Similar for other equipment. Status shall be based on:

1) Equipment in READY.

a) LOCAL/OFF/REMOTE selector switch selected in REMOTE position.

b) Power to CPT is ACTIVE.

c) Hardwired interlocks are NOT-ACTIVE.

2) Motor Overload is NOT-ACTIVE.

11. “Out of Service” (OOS) Selection:

a. Provide an “Out of Service” status indicator over pump graphic. Similar for other equipment. Status shall be based on:

1) Equipment in READY.

a) LOCAL/OFF/REMOTE selector switch selected in REMOTE position.

b) Power to CPT is ACTIVE.

c) Hardwired interlocks are NOT-ACTIVE.

2) Motor Overload is NOT-ACTIVE.

12. Values transmitted between PLC and VFDs / Soft Starters via Ethernet:

a. Transfer the following between the PLC and VFDs / Soft Starters:

1) Speed Output

2) Speed Input

3) Amps

4) KWH

5) Runtime

6) RPM

7) VFD/Soft Starter Failure

8) VFD/Soft Starter Ready

9) VFD/Soft Stater running

10) VFD/Soft Starter Fault code

C. Common control functions:

1. Incorporate common control functions into all control loops and devices and into the control programming, whether or not specifically shown in the specific control descriptions or elsewhere in the Contract Documents.

2. Alarms:

a. Generate alarms within the PLC logic.

b. Indicate alarms at the HMI and OIT. Enable acknowledgement from either the OIT or the HMI.

c. Generate high, high-high, low, and low-low level alarms where indicated:

1) Provide an alarm reset deadband for each analog value to prevent excessive repeated alarms.

2) Provide logic and timers to inhibit analog alarms based on process events. For example, inhibit low flow alarms when a pump is stopped, or has not been running long enough to establish flow.

d. Flash all alarm and fail conditions and their respective indicators on the PCIS graphic screens and local indicating lights until the condition is acknowledged by the operator, even if the alarm condition is no longer present.

e. Once the alarm is acknowledged by an operator, display alarm conditions in a steady state (not flashing) while the alarm condition is still present:

1) Flash with a cycle rate of 1/2 second on and 1/2 second off.

f. Once the alarm has been cleared and the operator has acknowledged the alarm or fail condition, turn the graphic alarm indicator off.

g. For all alarms that do not have inherent timers, provide an operator-adjustable proving timer to limit nuisance alarms, continuously adjustable from zero seconds to 100 minutes. The initial setting of proving timers shall be zero seconds:

1) The PLC shall start the timer when it first detects an alarm condition, and shall only activate the alarm after the timer has expired.

2) If the alarm condition clears while the timer is running, the timer shall reset, and the alarm shall not be activated.

h. Use interlocks and proving timers to prevent alarms from operating due to power loss, except for loss of power alarms.

i. Furnish an alarm silence pushbutton at each PCM, HMI, or LCP with an audible alarm to signal the PLC to turn off the audible alarm until the next alarm occurs.

j. Lamp test: Furnish lamp test pushbuttons at each control panel with more than 10 pilot lights, that illuminates all pilot lights on the panel:

1) The lamp test may sequence through blocks of lights.

2) Minimum on time for each lamp during lamp test 15 seconds.

k. For all alarms, provide an ENABLE/DISABLE button. An operator with sufficient security access will be able to make changes.

1) Disable status will prevent the alarm from being activated.

2) Enable status will allow the alarm to activate as described above.

3. Where a reset is shown for counts, totals and times maintained in the PLC:

a. Provide a reset selection on the OIT screen that displays the value.

b. Provide a preset function on the OIT to allow an operator-entered value to become the current accumulated total.

c. Limit access to the reset and preset functions to operators with suitable security level.

d. Log the value before reset, operator, time, and date of reset in the SCADA archive.

e. Log the value before preset, preset value, operator, time, and date of preset in the SCADA archive.

4. Where start counts are indicated on the Drawings, or required in this Section, count starts for each piece of equipment (off to on transitions of running status) in the PLC:

a. Display total starts on PCIS screens, and provide a reset function.

b. Where indicated, calculate number of starts for each day:

1) Display current day and previous day starts on PCIS displays.

2) Do not reset daily start count when overall count is reset.

3) Archive starts for each day through SCADA.

5. Where run time accumulation is indicated on the Drawings, or required in this Section, integrate accumulated run time to the nearest 0.1 hour whenever the running status input indicates that the equipment is running:
    a. Display total run time in hours on PCIS screens.
    b. Where indicated, calculate total run time for each day:
        1) Display current day and previous day run time on the OIT to the nearest 0.1 hour.
        2) Do not reset daily run time when overall time is reset.
        3) Archive run time for each day through SCADA.
6. For all monitored analog values:
    a. Convert all values to engineering units within the PLC.
    b. Maintain trends in SCADA.
    c. Totalized forward and reverse flows shall be transmitted from the flow meter where indicated on the drawings, or required in this section.
        1) Display totals on the OIT and HMI.
        2) Archive totals to the historical database through SCADA.
    d. Generate an alarm whenever an over-ride value is in use.
7. Analog data processing:
    a. Engineering units conversion:
        1) Use engineering units for all analog point values. Convert analog inputs to engineering units.
    b. Analog magnitude checking:
        1) Provide upper and lower limits to prevent operator-entered values (setpoints, etc.) from falling outside acceptable limits.
    c. Analog value quality:
        1) Monitor analog values received at each PLC from analog inputs or communications from another PLC or RIO, and generate alarms for the following conditions:
            a) Rate of change in excess of acceptable limit:
                (1) Provide a separate rate limit for each value.
            b) Stale value:
                (1) For analog signals that come from analog inputs or calculations using analog inputs, which are expected to have some variation each time the input is read, alarm when there is no change in the value for 10 times the normal expected scan or communication update.

8. Analog device override (HMI and OIT):

a. Provide the following functions from the OIT and the local HMI for each and every analog input:

1) An over-ride value to be used in place of the analog input:

a) Enter in engineering units:

(1) Display the calibrated range in engineering units.

(2) Only allow entries within the calibrated range of the instrument.

b) When the analog input is enabled, track the analog input so that the over-ride matches the analog input value when the input is initially disabled.

c) Maintain over-ride status and value in the PLC.

d) Only allow access to over-ride selections and settings to operators with sufficient security.

2) An enable/disable selection:

a) When enabled, the value used by the PCIS system is equal to the analog input value.

b) When disabled, the analog input is ignored, and the over-ride value is used for all control and display functions.

c) Generate an alarm whenever an analog input is disabled.

d) Enter a value for the analog input from the PCIS system to the PLC.

3) Use the over-ride value for all display and control functions instead of the actual analog input value.

b. Provide the following functions in the PLC, with selections and value entry from the OIT and/or HMI:

1) An over-ride value to be used in place of the normal output value:

a) Enter in percent of output span.

b) When the analog output is enabled, track the analog input so that the over-ride matches the analog output value when the output is initially disabled.

2) An enable/disable selection:

a) When enabled, the value sent to the output is the value determined by the PLC based on the control logic or operator-entered value in PCIS HAND.

b) When disabled, the calculated PCIS HAND values are ignored, and the over-ride value is sent to the output.

c) Generate an alarm whenever an analog output is disabled.

9. Tank and vessel levels:

a. Display all tank and vessel levels as both a level (typically in feet) and a volume (typically in gallons):

1) Some individual displays may be only level or volume, when agreed to by the OWNER and ENGINEER during screen meetings.

b. Monitor rate of change of volume on all tanks and vessels:

1) Establish the maximum withdraw rate at which the volume should decrease (all pumps or feeders operating at maximum output). Generate an alarm whenever the volume decreases faster than this rate.

2) Establish the minimum fill rate at which the volume should increase when filling. Generate an alarm whenever the volume increases faster than this rate. Verify tank and vessel level is fluctuating to verify the validity of the IO register. If it is determined the register is not active or failed in a manner that leaves a stagnant value generate an alarm.

10. I/O filtering and processing:

a. Analog input filtering:

1) For each analog input provide an adjustable first order filter, for the purpose of smoothing out spikes and other noise for analog transmitter input signals. By default, configure analog inputs with no filtering affect.

2) Monitor analog input signal quality:

a) Over range: The input value is above the normal range (typically over 21 mA).

b) Under range: The input value is below the normal range (typically under 3 mA, indicating a probable broken connection).

c) Generate alarms for over or under range inputs.

d) Do not use over or under range values for control or calculation purposes:

(1) Where a second instrument is provided to monitor the same condition (a redundant instrument, or additional instruments furnished for averaging or different

operating modes), and has a valid signal, use that input for control.

(2) Otherwise, hold all outputs affected by the signal at their last values before the signal went out of range.

3) Digital input filtering (proving timer):

a) Provide an adjustable time delay function (0-10 seconds) on discrete input for the purpose of de-bouncing.

b) By default, discrete inputs shall be configured with de-bounce timers set to zero seconds.

11. Instrument scaling (OIT/HMI):

a. Provide 1 or more maintenance screens to display ranges and trigger points for all field instruments:

1) For analog instruments, use input scaling values in the PLC to determine minimum and maximum calibration points.

2) For discrete instruments, display calibrated pick-up and drop-out values.

12. PCIS HAND-OFF-AUTO:

a. Where indicated, provide HAND-OFF-AUTO and START-STOP selections in the PCIS, accessed from an HMI or OIT for operators with sufficient security, to provide the following operating modes:

1) PCIS AUTO: The normal, automatic control mode of the strategy which allows full PLC control in response to process conditions and programmed sequences.

2) PCIS HAND: Enables PCIS Manual control where control decisions are made by an operator through the PCIS START-STOP, OPEN/CLOSE, or other selections as indicated.

3) PCIS OFF: Automated PCIS control is disabled and PLC calls for all associated equipment to stop and valves to close or go to their identified safe state.

4) Program the PLC so that switching a strategy between AUTO and HAND (either direction) occurs with a smooth transition. Keep running or position status unchanged when control is switched to HAND until a change is requested using the operator selections (START, STOP, OPEN, CLOSE). Keep running and position status unchanged when control is switched to AUTO until the control logic determines a change is required.

13. Display the current status of all operator selections (PCIS HAND/AUTO, PCIS START/STOP, etc.) on HMI and OIT.

14. Permissives:

    a. Implement software permissives where indicated to place equipment in a safe condition in response to impending hazardous process conditions. Apply software permissives when equipment is operating in PCIS AUTO or PCIS HAND:

        1) Where indicated, provide a selection to bypass software permissives for maintenance functions. This option shall only be selectable in PCIS Manual.

    b. Use hard-wired permissives for equipment protection where indicated.

15. Process control algorithms:

    a. Jog and hold: Unless otherwise indicated, use jog and hold control algorithms where possible:

        1) When the error between process variable and setpoint is beyond a setpoint deadband:

            a) Jog valve or ramp speed in the required direction for a preset “Jog Time” or until the process variable reaches or passes the setpoint.

            b) Then hold speed or position through a setpoint “Hold Time.”

            c) Continue alternating jog and hold until the error is less than the deadband.

        2) Provide operator access to Jog Time and Hold Time setpoints from the OIT.

    b. PID algorithms: Use where indicated, or where necessary to provide fast response:

        1) Provide a PID faceplate with the following displays and functions for each PID control algorithm:

            a) Display Output, CV.

            b) Display Setpoint, SP.

            c) Display Process Variable, PV.

            d) Allow for operator selection of Automatic or Manual control of the output.

            e) Under Manual control of output allow the operator to enter the desired output value.

            f) Allow for input of the three Proportional, Integral and Derivative tuning parameters.

            g) Configure PID loops to prevent reset windup when controlled equipment is operating in Manual (local or PCIS), or when the equipment has reached a physical limit.

h) When controlled equipment is being operated in remote PCIS HAND, configure the PID function to track the process variable to provide a smooth transfer between Manual and Automatic modes.

i) Provide selectable slew rates with adjustable setpoints to allow the PID algorithm to slowly ramp to its final value to minimize system disturbance.

16. Equipment alternating and sequencing:

    a. Distribute number of starts and run time equally between identical equipment.

    b. Distribute cell order backwashing

    c. Provided selection for fixed equipment sequencing.

    d. Remove equipment from alternating if “Out of Service”.

17. Motor control:

    a. Monitor the device’s LOCAL-OFF-REMOTE (LOR) switch (the hard-wired switch at the MCC, drive or equipment) to determine when the PLC has control of the associated equipment:

        1) Display current REMOTE status on the PCIS screens.

    b. Monitor the device’s running status from the starter auxiliary or run status input:

        1) Display the current status (running or stopped) on the PCIS screens.

        2) Use status to calculate total run time and daily run time, and to count total starts and daily starts.

        3) Provide time stamp for each start.

        4) For motors 200 HP and greater, provide software to prevent exceeding the manufacturer’s recommended maximum starts per hour.

    c. When equipment control has been given to the PLC as reported by the LOCAL-OFF-REMOTE switch, allow selection of PCIS AUTO or PCIS HAND control modes based upon operator selection using the PCIS screens.

    d. Starting, stopping and running when the device LOR is in LOCAL:

        1) With the LOR switch in the Local position, the motor is controlled by the START and STOP pushbuttons.

        2) With the LOR switch in the OFF position, the motor is prohibited from running.

        3) With the LOR switch in the REMOTE position, the motor is controlled remotely.

    e. Starting, stopping and running when the device LOR is in REMOTE:

1) When the motor is expected to be running (PLC has issued a START or RUN due to process conditions or operator selection), LOR is in REMOTE, and the device is not reported to be running, start an operator adjustable “Control Activation” timer:

a) Provide “Control Activation” timers for each piece of controlled equipment:

(1) If the LOR and required running status do not change, and the PLC does not receive running status within the “Control Activation” time period:

(a) De-activate the output.

(b) Place the device in a “Failed” state.

(c) Generate a “Failed to Respond” alarm.

2) When the motor is not expected to be running (PLC has issued a STOP or removed the RUN output), LOR is in REMOTE, and the device is reported to be running, start the “Control Activation” timer:

a) If the LOR and required stopped status do not change, and the PLC does not lose the running status within the “Control Activation” time period:

(1) Keep the RUN output off or the STOP output on.

(2) Place the device in a “Failed” state.

(3) Generate a “Failed to Respond” alarm.

3) Re-establish PLC control of a device in a “Failed” state only after an operator turns the device’s LOR switch out of REMOTE, and back to REMOTE (i.e., REMOTE input to the PLC cycles off and back on).

f. Where motor winding high temperature switches or RTD temperature elements are shown, generate an alarm when high temperature is sensed (contact opens or temperature above the high alarm setpoint), but do not stop the motor unless otherwise indicated.

g. Control two-speed motors similar to other motors, except as listed below:

1) Motor states are RUN-FAST, RUN-SLOW, and STOP.

2) Start all two-speed motors in the RUN-SLOW state. If or when the high speed is required (RUN-FAST operator selection or process conditions), transition to RUN-FAST after a designated time.

3) When transitioning from RUN-FAST to RUN-SLOW, remove the RUN-FAST output or issue a STOP, then wait for a “Fast to Slow” time delay before energizing the RUN-SLOW or START-SLOW output.

h. Simultaneous starts:

1) Prevent more than one motor-driven load 25 HP or larger in the same facility from starting concurrently:

a) When starting one load, inhibit start logic for all other such equipment until the load being started is up to speed (RVSS or VFD), or after a setpoint time delay (full-voltage starters and miscellaneous equipment).

2) Use the same logic to prevent multiple large devices from starting concurrently on restoration of power after a power outage, whether operating on generator or utility power.

i. Speed control:

1) Modulate speed on VFD-driven motors using jog and hold, or PID control algorithms to maintain process conditions as described in the specific loop descriptions.

2) Operate speed control within a pre-defined range:

a) Minimum speed as determined by equipment manufacturer. The higher of:

(1) Minimum motor speed to maintain adequate cooling for the type of load driven (constant or variable torque).

(2) Minimum equipment speed, such as minimum speed to deliver flow or to deliver minimum flow for equipment cooling or lubrication.

b) Maximum speed 100 percent (60 Hz) or as identified by equipment manufacturer.

3) Where multiple equipment may operate together to maintain the same process condition:

a) Provide an operator selection for starting sequence.

b) Start the first equipment at a preset starting speed.

c) When one or more equipment is running and the speed control algorithm reaches a preset “Start Next” speed value (initially 95 percent of speed range) through a preset time delay:

(1) Start the next available equipment at the preset starting speed.

(2) Ramp speed of previously running equipment down to a preset value based on

the number of items running. Determine preset values for each condition based on equipment and system characteristics to provide approximately the same total flow or process condition with the new load running at the starting speed.

(3) Once the previously-running equipment reaches the preset speed, resume the speed control algorithm for those equipment.

(4) Ramp the speed of the equipment that had just started until it reaches the speed of the previously-running equipment.

(5) Operate all equipment at the same speed following the output of the speed control algorithm.

d) When two or more pieces of equipment are running, monitor for a “Stop Next” condition:

(1) Where flow rate is monitored, use a preset “Stop Next” flow rate for each possible number and combination of equipment:

(a) Determine initial “Stop Next” speed based on the flow that can be provided with one fewer piece of equipment running at a speed slightly below the “Start Next” speed.

(2) When the “Stop Next” condition exists through a preset time delay:

(a) Ramp speed of running equipment except for the equipment to be stopped up to a preset value based on the number of items running. Determine preset values for each condition based on equipment and system characteristics to provide approximately the same total flow or process condition with one fewer load running (typically slightly below the preset “Start Next” speed) while ramping speed of equipment to be stopped down to the preset minimum speed.

(b) Stop the load once it reaches minimum speed.

(c) Operate all remaining equipment at the same speed following the output of the speed control algorithm.

18. Gate and valve control:

a. Monitor the device's LOCAL-OFF-REMOTE (LOR) switch(es) (the integral switch in the actuator or hard-wired switch at the local control station):

1) Display current REMOTE status on PCIS screens.

b. Start an "Open Activation" timer whenever the device is expected to be open (PLC has issued an OPEN command in PCIS AUTO, or OPEN was selected in PCIS HAND):

1) Initially set "Open Activation" time to twice the normal opening time.

2) If the LOR position and open command do not change, and the PLC does not receive fully open status feedback within the "Open Activation" time period:

a) De-activate the open output.

b) Place the device in a "Failed" state.

c) Generate a "Failed to Open" alarm.

c. Start a "Close Activation" timer whenever the device is expected to be closed (PLC has issued a CLOSE command in PCIS AUTO, or CLOSE was selected in PCIS HAND):

1) Initially set "Close Activation" time to twice the normal closing time.

2) If the LOR position and close command do not change, and the PLC does not receive fully closed status feedback within the "Close Activation" time period:

a) De-activate the close output.

b) Place the device in a "Failed" state.

c) Generate a "Failed to Close" alarm.

d. For modulating valves (valves controlled from either a 4-20 mA signal or digital communications command) with position feedback, start a "Position Error" timer whenever the position feedback differs from the required position command by more than a setpoint error when the LOR is in REMOTE:

1) For analog modulating devices, error is determined by position feedback differing from position command by more than the setpoint error.

2) For discrete modulating devices, error is determined by feedback not changing in the correct direction, or changing at less than a setpoint rate, when the OPEN or CLOSE PLC output is active.

3) Initially set the “Position Error” time to 60 seconds.

4) If the LOR position does not change, and position error stays outside of the setpoint error through the “Position Error” time period:

a) Hold position output.

b) Place the device in a “Failed” state.

c) Generate a “Position Fail” alarm.

e. Provide separate time delay settings for each function and for each device.

f. If the valve position inputs indicate an impossible state (i.e., valve open and closed at the same time), place the device in a “Failed” state and generate an “Illegal State” alarm.

g. Re-establish PLC control of a device in a “Failed” state only after an operator turns the device’s LOR switch out of REMOTE and back to REMOTE (i.e., REMOTE input to the PLC cycles off and back on).

h. For all alarm conditions, control other devices (as stopping pumps, etc.) as stated in the individual loop descriptions to make the system safe.

i. For discrete modulating valves (valves positioned to intermediate positions to control process values through discrete OPEN and CLOSE outputs), count the number of actuations (OPEN or CLOSE commands) in the PLC:

1) Display count on the OIT.

2) Provide a reset function for the count.

19. Chemical systems (HMI/OIT):

a. Provide the following chemical system screens:

1) Where one HMI manages more than one chemical system, a main menu screen that will allow the operator to access the individual chemical system screens using software keys.

2) One or more screens for each individual chemical system controlled at that location, containing:

a) All status displays (running, failed, etc.).

b) Selections (lead/lag, which process flow to pace to, etc.).

c) Setpoint entry and display.

d) Calculated feed requirement (result of flow pacing calculation) in engineering units (typically milligrams of chemical per minute).

e) Output signal to feeder in percent of full span.

f) Actual chemical flow rate from flowmeter (where shown).

g) Process flow rate(s) used to pace each chemical on the individual chemical screens (PROC FLOW):

(1) Where different process flows can be selected for flow pacing, display and identify the selected source.

3) Chemical system calculations: Perform calculations as indicated on the Drawings or in Specifications and in the individual loop descriptions. Use the following assumptions, unless otherwise noted.

a) Where chemical flow feedback is not used, assume feeder output is linear in response to control signal.

b) Zero signal (typically 4 milliamperes) produces zero flow.

c) Perform flow-pacing calculations using as indicated on the Drawings or described in the individual loop descriptions.

b. Provide the setpoints and selections indicated on the Drawings and in the individual loop descriptions. Typical setpoints include:

1) QMAX: Maximum calibration value:

a) Chemical flow rate measured from calibration column at maximum feeder output (typically in gallons of solution per hour or milliliters of solution per minute).

2) CONC: Chemical concentration:

a) The concentration of the chemical in the solution to be fed, in engineering units (typically milligrams of chemical per liter of chemical solution).

3) DENSITY:

a) Density of the chemical solution to be fed in engineering units or as a specific gravity.

b) Used to calculate the concentration of the chemical in the solution.

4) DOSE: Desired dosage:

a) Desired chemical concentration in the process stream in engineering units (typically milligrams of chemical per liter of process fluid).

5) FLOW SEL: Selection of process stream(s) for flow pacing.

6) OPEN/CLOSED LOOP:

a) Selection of method of controlling chemical flow-paced feed rate.

b) OPEN LOOP: Signal to feeder is based on feeder calibration (QMAX) to deliver calculated chemical solution feed rate. Chemical solution flowmeter is not used for control.

c) CLOSED LOOP: Chemical feed rate is directly controlled using the calculated chemical solution feed rate as the setpoint, and the flow rate from the chemical solution flowmeter as the process variable.

20. Breaker status: (NOT APPLICABLE)

a. Display the following data to the extent it is available from the specified device:

1) Open.

2) Closed.

3) Tripped.

4) Ground fault.

5) Relay failure.

6) Communications error.

21. Power and starter information:

a. Retrieve data via power quality meters, motor protection relays, digital bus networks, or metering instruments, as indicated.

b. Display the following data to the extent it is available from the specified device:

1) Current: [A]:

a) A-Phase.

b) B-Phase.

c) C-Phase.

2) Volts: [V]:

a) A-B Phase to Phase.

b) B-C Phase to Phase.

c) C-A Phase to Phase.

(1) Reactive power: [kVAR].

(2) Real power: [kW].

(3) Apparent power: [kVA].

(4) Power factor: 0.8 percent.

c. For engine/generator system monitoring, also display percent of rated output.

22. Starters, RVSS and VFDs equipped with digital bus communications:

    a. Communicate and display all values listed in the equipment specifications, indicated on the Drawings, or listed below.

    b. Communicate VFD Speed and VFD feedback over the Modbus network.

    c. Monitor the following additional values, and display on the OIT:

        1) Motor current.

        2) Over current alarm.

        3) Under current alarm.

        4) Running status.

        5) Phase loss.

        6) Stall.

        7) Not ready alarm.

        8) Number of starts.

        9) History of past 5 trips.

    d. For Variable Frequency Drives:

        1) Speed command.

        2) Speed feedback.

    e. For RVSS, Variable Frequency Drives, and where otherwise shown or available, monitor the following over the digital bus network:

        1) Line voltage.

        2) Power.

        3) Power factor.

        4) Over voltage alarm.

        5) Under voltage alarm.

        6) Over current alarm.

        7) Under current alarm.

23. Instruments equipped with digital bus communications:

    a. Communicate and display all values listed in the equipment specifications, indicated on the Drawings, or listed below.

    b. Instrument diagnostics.

    c. Communications health.

    d. Process variable.

    e. Alarm summary.

    f. All totalizers (if applicable).

24. Valves and gate operators equipped with digital bus communications: (NOT APPLICABLE)

    a. Communicate and display all controls and data listed in the equipment specification, as indicated on the Drawings, or listed below:

        1) Open, close or direct position commands.

        2) Fully open and closed status.

        3) Position.

        4) High torque, overload and other applicable alarms.

    b. Establish initial torque curves using manufacturer's software for performance tracking and wear.

25. Plant shutdown: Provide OOS for all equipment using a single bit for every device and a picture that displays status of all equipment for each area.

26. OUT OF SERVICE (OOS) Selection:

    a. Where indicated, provide OUT OF SERVICE (OSS) selection in the PCIS, accessed from an HMI or OIT for operators with sufficient security, to place equipment OUT OF SERVICE.

        1) Automated PCIS control is disabled and PLC calls for equipment to stop.

        2) Equipment rotation will be set to bottom of list

        3) All associated equipment alarms will be blocked.

        4) Place OUT OF SERVICE (OSS) indicator block over equipment graphics.

27. Power failure:

    a. Retain all operating setpoints during power failure.

    b. Restore plant operation to the state it was before the power loss:

        1) Store the operating state of all major equipment and systems in the PLC, and retain the last state during a power loss.

        2) When transferring to generator power, provide a load sequence table on the workstation screen showing the major equipment and systems, and providing a "re-start" selection. (NOT APPLICABLE)

            a) For each item, list the following:

            b) Equipment name and tag.

            c) Running kW and kVA.

            d) Starting kW and kVA.

            e) Identify whether it was running immediately before the power loss.

f) Show current running and available status.

g) Operator selection to re-start:

(1) Do not allow selection of loads that will cause the generator starting or running capacity to be exceeded.

(2) Insert a sequence number showing the order in which the load was selected. If a load is selected again, remove it from the queue, and update the sequence numbers for the remaining equipment.

h) When operating on generator power, also display the following, updating as selections are made, and as load:

(1) Generator(s) operating.

(2) Generator(s) available.

(3) Remaining running and starting kW and kVA:

i) Calculate from measured generator output kW and kVA, and the maximum starting and running capacity required to start the selected loads.

j) Once the operator has selected loads, and selected “re-start”:

(1) Start the process loads in the order they were selected.

(2) Use the logic described above for preventing concurrent starts to provide necessary delays between each step.

k) After the initial loads have been sequenced on, allow automatic operation to continue to stop and start loads within generator capabilities.

l) Provide an operator selection to permit the plant to re-start. Once re-start is selected: Allow plant loads to re-start, and allow loads to sequence on and ramp up following normal control logic. Where loads were operating in PCIS HAND, restore their operation to the state before the power loss:

3) Use the logic described above for preventing concurrent starts to provide necessary delays between each start.

c. Operating on generator power:

1) Include running and starting kW and kVA requirements for each major equipment and system in registers in the PLC:

a) Where running load can vary due to speed, valve position, etc., use the normal starting value plus 25

percent of the difference between the maximum and minimum values.

2) Inhibit starting of loads from process control logic and from operator selection (in PCIS HAND) that will exceed generator capability.

3) Allow entry of portable generator kW rating to generate capacity alarms.

4) Generate the following alarms:

   a) Generator near capacity: When measured kW or kVA reaches 90 percent of the rating of running generators.

   b) Generator at capacity: When measured kW or kVA reaches 95 percent of the rating of running generators.

   c) Unable to start: When an operator selects a load that would exceed generator starting or running capacity.

   d) Insufficient capacity: When the control system needs to start a load, but is inhibited due to generator capacity.

5) Whenever the Generator at Capacity alarm is active, inhibit starting of any loads, and inhibit increase in speed of all control loops, and other changes that would increase electrical load.

6) For multiple generator systems, coordinate capacity alarms and equipment starting with generator control system to ensure adequate generator capacity, and to prevent alarms.

7) Display the following power system data on the workstation screen in numerical and graphical formats:

   a) Available power.

   b) Current power demand.

   c) Capacity of the generator.

   d) Current power demand load as a percentage of capacity.

   e) Generator frequency.

8) Provide transition time before restoring to normal. After a time delay (adjustable) when power is available provide a shut down that allows the equipment to transition back to utility power.

3.02 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

END OF SECTION

SECTION 17101

SHASTA WATER FACILITY SPECIFIC CONTROL STRATEGIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Loop descriptions:
      a. Specific control requirements and functional descriptions for individual control loops.

B. Related sections:
   1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
   2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
   3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
      a. Section 01330 - Submittal Procedures.
      b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Develop detailed loop descriptions based on the information in the Contract Documents, and submit as specified in Sections 01330 and 17050.
   1. For each control loop, provide a detailed functional description of the operation of the equipment, signals, and controls shown on the P&IDs:
      a. Include all functions depicted or described in the Contract Documents.
      b. Include the following within each loop description:
         1) All requirements specific to that loop.
         2) Common control requirements applicable to that loop.
         3) List of all ranges, setpoints, timers, values, counters, etc.
   2. Where there are similar loops with identical control, such as multiple loops for individual raw water pumps, only 1 loop description need be developed and the remaining loops may reference that loop description.

B. Loop description format:
   1. Loop number and title.
   2. References:
      a. List P&IDs that are specifically referenced.
   3. Abstract:
      a. General description of how the loop works, what devices are involved, and how the process will be controlled.
      b. Process values, setpoints, and limits, including units and ranges:
         1) Show span and range values for analog inputs and outputs, and operating point and deadband for discrete inputs.
   4. Hardwired control:
      a. Detailed description of the control functions at the local level.
      b. Function of local operator interfaces.
      c. Operation of hardwired field pilot controls:
         1) Pushbuttons.
         2) Selector switches.
         3) Potentiometers.
         4) Pilot lights, indicators, and other displays.
   5. Hardwired interlocks:
      a. Explanation of the operation of system interlocks and hardwired permissive conditions.
   6. PLC control:
      a. Detailed description of the control functions that are under control of the PLC.
      b. Operator controls and automatic controls.
      c. Setpoints, alarms, etc.:
         1) Include units and ranges for analog values.
         2) Include span and range for analog inputs and outputs.
         3) Include operating point and deadband for discrete inputs, and identify conditions where contacts are open, and when they close.
      d. Control sequences.
   7. Software interlocks:
      a. Operation of system software interlocks.
   8. HMI control:
      a. Detailed description of the operator controls.
   9. SCADA control:
      a. Detailed description of the operator controls.
      b. Setpoints, alarms, etc.
   10. Indicators and alarms:
      a. List any indicators and alarms specific to the loop that are not covered in the common control strategies.
   11. Failure modes:
      a. List any failure modes specific to the loop that are not covered in the common control strategies.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 WELL 165 SYSTEM (10GW)

A. References:
   1. Process Area: Water Well.
   2. P&ID Drawing: P2.
   3. Mechanical Drawings: M201.
   4. Specification Sections: 11301.

B. Mechanical Equipment:

Tag Number	Equipment Name
10GW-P101	Well 165 Pump
10GW-MOV104	Well 165 Pump to Waste Valve
10GW-SV106	Well 165 Pre-Lube Valve

C. General Description:
   1. The 4MG Water Storage Tank will either be filled from SYSTEM PRESSURE or from WELL 165 PUMP. A SCADA/OIS STORAGE TANK FILL Selector switch shall be provided to select between the two methods to fill the Tank.
      a. There will also be a SCADA/OIS Selector switch TIME OF DAY Mode option for WELL 165 PUMP. If this mode is ENABLED, the Well Pump will be prevented from operating between a START TIME (adjustable) and STOP TIME (adjustable) TIME OF DAY. If the mode is DISABLED, the Well pump will be called when necessary.
      b. There will also be an EMERGENCY FILL MODE – Regardless of Water Storage Tank operational mode, if the System (discharge) pressure 60FW-PIT061 is less than the Emergency START PRESSURE setpoint (adjustable) and the Water Storage Tank level 51ST-LIT050 is less than a START LEVEL setpoint (adjustable), call Well pump to start.
   2. The Well is sized to produce water for two filters. It will eventually shut down on lockouts if both filters are not operating (either Filtering or Backwashing).

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) Well 165
            a) High Discharge Pressure switch (10GW-PSH101).
            b) Low Flow Lube Water Flow switch (10GW-FSL105)
            c) Well 165 Pressure (10GW-PIT011)
            d) Well 165 Flow (10GW-FIT012)
         2) Methane Treatment System.
            a) Ultrasonic type level transducer (20MH-LT030).
            b) High High Level Switch (20MH-LSHH016)
         3) Water Storage Tank.
            a) High High Level Switch (50ST-LSHH066)
   2. Local Control Panel:
      a. Control Devices:
         1) None
      b. Indicators and Alarms:
         1) None

E. MCC Controls and Instrumentation:
   1. MCC Panels:
      a. MCC Control Devices.
         1) LOCAL/OFF/REMOTE selector switch.
         2) Control Power (CP) ON/OFF selector switch.
         3) SSS (Solid State Starter) RESET pushbutton.
         4) HI PRESSURE RESET pushbutton.
      b. Indicators and Alarms:
         1) READY indication.
         2) READY status for well pump. Well Pump is READY under the following conditions:
            a) The equipment is in REMOTE.
            b) The CPT is active.
            c) The hardwired High Discharge Pressure Switch is not active.
            d) The hardwired Methane Sump High High level switch is not active.
            e) The hardwired Backwash Recycle Tank High High level switch is not active.
            f) The hardwired Water Storage Tank High High level switch is not active
            g) There is not an active soft starter FAIL alarm.
         3) RUN indication.
         4) RUN status for well pump.
         5) FAIL indication.
         6) FAIL ALARM for well pump.
         7) LOW WATER FLOW ALARM for pre-lube water.
      c. Hardwired Interlocks:
         1) In both the LOCAL and REMOTE modes, when the Well pump is called to start, OPEN the Pre-Lube water solenoid valve prior to starting the pump.
         2) The Pre-Lube water solenoid valve is hardwired to energize when the Well Pump is called to Start or when the Well Pump is started in LOCAL. An adjustable time delay relay (0-600 seconds, set at 60 seconds) will delay the start of the Well Pump.
         3) A Low Flow switch is hardwired to shutdown the pump to prevent operation if the Pre-Lube flow switch hasn't been activated after a timer delay. Well Pump must have pre-lube water prior to running. The Low Flow switch also provides an alarm to the PLC.
         4) A High Pressure switch is hardwired to shutdown the pump to prevent operation if the discharge pressure is above the High pressure switch setpoint. The High Pressure switch also provides an alarm to the PLC. This alarm requires a MANUAL reset with a pushbutton at the MCC.
         5) A High-High Level switch is hardwired to shutdown the pump to prevent operation if the Methane sump level is above the High-High Level setpoint. The High-High Level switch also provides an alarm to the PLC.
         6) A High-High Level switch is hardwired to shutdown the pump to prevent operation if the Backwash Recycle Tank level is above the High-High Level setpoint. The High-High Level switch also provides an alarm to the PLC.

7) A High-High Level switch is hardwired to shutdown the pump to prevent operation if the Water Storage Tank level is above the High-High Level setpoint. The High-High Level switch also provides an alarm to the PLC.

F. PLC/OIS Functions:
1. Control:
a. General
1) RUN and READY status of the Well Pump are transmitted from the MCC to SCADA for indication.
2) SCADA shall accumulate Well Pump run time for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, previous 14 days, month to date, and previous calendar month.
3) AUTO/MANUAL switches shall be provided in SCADA for Well Pump and Pump to Waste Valve.
4) A START/STOP switch shall be available for manual control of the pump from SCADA.
b. SCADA Manual Control Mode
1) If the Well pump is not in REMOTE, then SCADA shall indicate it is NOT IN REMOTE.
2) When LOCAL/ OFF/ REMOTE selector switch for Well Pump is in REMOTE position and IN SERVICE, the Operator may place the Well pump in MANUAL and start and stop the well pump from SCADA, which will operate the well pump until the Operator changes the operation.
3) In the SCADA MANUAL MODE, Pump to Waste Valve may manually OPEN or CLOSE it from SCADA.
c. SCADA Automatic Control Mode
1) When LOCAL/ OFF/ REMOTE for Well Pump is in REMOTE and IN SERVICE and the STORAGE TANK FILL SCADA/OIS switch is in WELL, starting and stopping of the well pump shall be based on the level in the Water Storage Tank.
2) If the Water Storage Tank is less than a START setpoint (adjustable) after an adjustable time delay, then call the well pump to operate.
3) EMERGENCY FILL MODE – When LOCAL/ OFF/ REMOTE for Well Pump is in REMOTE and IN SERVICE and regardless of Water Storage Tank operational mode, if the System (discharge) pressure is less than the Emergency START PRESSURE setpoint (adjustable) and the Water Storage Tank level is less than a START LEVEL setpoint (adjustable), call Well pump to start.
4) The Pump to Waste Valve will open on Well Pump start. The Pump to Waste duration will be determined by the Operator. After timing out, the Pump to Waste Valve will close and water will flow to the Methane Treatment system.
5) If the Water Storage Tank is greater than an adjustable STOP setpoint after an adjustable time delay, then remove the pump call to stop the pump.
2. Screen Indicators and Alarms at PLC/OIS:
a. System
1) Well 165:

a) STORAGE TANK FILL mode indication
b) Well 165 Drawdown Level Indication.
c) Well 165 Discharge Pressure Indication.
d) Well 165 Discharge Flow indication.
e) RUN indication.
f) Run time meter: SCADA shall accumulate total pump run time and starts for each pump for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, current week, month to date, previous calendar month and total runtime
g) READY status: The status shall be transmitted to SCADA when a common alarm is not activated, the local selector switch is in REMOTE position, the pump is ready to run and the following alarm conditions are not active:
(1) The hardwired High High Discharge Pressure Switch is not active.
(2) The hardwired Methane Sump High High level switch is not active.
(3) The hardwired Backwash Recycle Tank High High level switch is not active.
(4) The hardwired Water Storage Tank High High level switch is not active
(5) There is not an active soft starter FAIL alarm.
h) COMMON FAIL ALARM: An alarm shall be transmitted to SCADA for motor overload, pump fail, high discharge pressure, low seal water flow, and excessive starts per hour.
i) Well 165 Pump OUT OF SERVICE status.
j) Well 165 FAIL TO RESPOND ALARM indication.
k) HIGH Well 165 discharge pressure (switch) ALARM.
l) HIGH Well 165 discharge pressure ALARM
m) LOW Well 165 discharge pressure ALARM (only if pump is running and Pump to Waste Valve is closed)

2) Well 165 Pump to Waste valve:
a) OPENED status.
b) CLOSED status.
c) FAIL status.
d) OUT OF SERVICE status.

3) Water Levels:
a) AERATION BASIN SUMP level indication.
b) HIGH HIGH Aeration Basin Sump ALARM.
c) BACKWASH RECYCLE TANK level indication.
d) HIGH HIGH Backwash Recycle Tank ALARM.
e) WATER STORAGE TANK level indication.
f) HIGH HIGH Water Storage Tank ALARM.
g) Level Instrument Fail ALARM (for each instrument)

b. Software Interlock:

1) The Well pump shall also stop on the following conditions:
a) Well 165
(1) Low-Water Flow for Well 165 Lube Water
(2) Well 165 Pump FAIL.
(3) Well 165 FAIL TO RESPOND.

(4) HIGH HIGH Well 165 discharge pressure ALARM.

b) Methane Removal

(1) HIGH HIGH Methane Sump level ALARM.

c) Filters

(1) Any FIILTER VALVE FAIL ALARM– requires local reset at HMI

(2) Signal FAIL for any Filter influent flowmeter

d) Water Storage Tank

(1) HIGH HIGH Water Storage Tank level ALARM.

e) Chemical System

(1) LOW CL2 residual post filter ALARM.

(2) HIGH HIGH CL2 residual post filter ALARM.

(3) LOW CL2 residual Treated Water Pump Station ALARM.

(4) HIGH HIGH CL2 residual Treated Water Pump Station ALARM.

(5) CL2 Cylinders de-energized

(6) LOW fluoride residual ALARM.

(7) Fluoride Unit FAIL ALARM.

(8) HIGH HIGH CL2 Chlorine gas leak ALARM.

f) FILTER BACKWASH FAIL ALARM – requires local reset at HMI

(1) High Backwash flow alarm.

(2) High Filter rinsing flow alarm.

g) BACKWASH RECYCLING ALARM– requires local reset at HMI

(1) Backwash Recycle valve FAIL

(2) Signal FAIL for Backwash Recycle flowmeter

(3) Signal FAIL for the Backwash Recycle Tank level transmitter (40GW-LIT40)

(4) HIGH Backwash Recycle flow ALARM.

(5) HIGH HIGH Backwash Recycle Tank ALARM.

2)

3) The Pump to Waste Valve will open on Well Pump start. The Pump to Waste duration will be determined by the Operator. After timing out, the Pump to Waste Valve will close to allow water to flow to the Methane Treatment system.

c. Alarms Generated by SCADA:

1) SCADA shall alarm on Excessive Starts per Hour. Initially Excessive Starts per Hour shall be set at 6 starts per hour (0-12 starts per hour).

G. Special Considerations:

1. Power outage and restore operation.

a. During power outages, the well pump with associated valves and filters will not operate due to loss of power. The well system alarms will be de-activated at SCADA during power outages. Upon restoration of the power, well pump and associated equipment shall resume normal operation (pump and valves called based on the sequence of operation) to fill Water Storage Tank. Alarms will be re-activated at SCADA upon restoration of power.

3.02 AERATION BLOWER (20MH)

A. References:
   1. Process Area: Methane Treatment.
   2. P&ID Drawing: P3.
   3. Mechanical Drawings: M301.
   4. Specification Sections: 11375.

B. Mechanical Equipment:

Tag Number	Equipment Name
20MH-B202	Aeration Blower

C. General Description:
   1. The Aeration Blower will run when the well pump is running and water isn't being diverted for Pump to Waste.

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) Aeration Basin Sump High High Level Switch (20MH-LSHH016)
   2. Local Control Panel:
      a. Control Devices:
         1) None
      b. Indicators and Alarms:
         1) None

E. MCC Controls and Instrumentation:
   1. MCC Panels:
      a. MCC Control Devices.
         1) LOCAL/OFF/REMOTE selector switch.
         2) Control Power (CP) ON/OFF selector switch.
         3) Full Speed Starter RESET pushbutton.
      b. Indicators and Alarms:
         1) READY indication.
         2) READY status for aeration blower. Aeration Blower is READY under the following conditions:
            a) The equipment is in REMOTE.
            b) The CPT is active.
            c) There is not an active motor starter FAIL alarm.
         3) RUN indication.
         4) RUN status for aeration blower.
         5) FAIL indication.
         6) FAIL ALARM for aeration blower.
      c. Hardwired Interlocks:
         1) None

F. PLC/OIS Functions:
   1. Control:
      a. General
         1) RUN and READY status of the Aeration Blower are transmitted from the MCC to SCADA for indication.

2) SCADA shall accumulate Aeration Blower run time for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, previous 14 days, month to date, and previous calendar month.
3) AUTO/MANUAL switch shall be provided in SCADA for Aeration Blower.
4) A START/STOP switch shall be available for manual control of the blower from SCADA.

b. SCADA Manual Control Mode
1) If the Aeration Blower is not in REMOTE, then SCADA shall indicate it is NOT IN REMOTE.
2) When LOCAL/ OFF/ REMOTE selector switch for Aeration Blower is in REMOTE position and IN SERVICE, the Operator may place the Well pump in MANUAL and start and stop the Aeration Blower from SCADA, which will operate the well pump until the Operator changes the operation.

c. SCADA Automatic Control Mode
1) When LOCAL/ OFF/ REMOTE for Aeration Blower is in REMOTE and IN SERVICE, starting and stopping of the Aeration Blower shall be based on the Well Pump operation and Well 165 flow.
2) If the Well 165 flow is greater than a START setpoint (~100GPM adjustable) after an adjustable time delay and Well pump is running, then call the Aeration Blower to operate.
3) If the Well 165 flow is less than an adjustable STOP setpoint after an adjustable time delay or Aeration sump is greater than a warning water level (adjustable) or Well Pump is off, then remove the blower call to stop the blower.

2. Screen Indicators and Alarms at PLC/OIS:

a. System:
1) Aeration Blower:
a) Well 165 Discharge Flow indication.
b) RUN indication.
c) Run time meter: SCADA shall accumulate total blower run time and starts for blower for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, current week, month to date, previous calendar month and total runtime
d) READY status: The status shall be transmitted to SCADA when a common alarm is not activated, the local selector switch is in REMOTE position, the blower is ready to run and the following alarm conditions are not active:
e) There is not an active motor starter FAIL alarm.
f) COMMON FAIL ALARM: An alarm shall be transmitted to SCADA for motor overload, pump fail, and excessive starts per hour.
g) Well 165 RUN indication.
2) Water Levels:
a) AERATION BASIN SUMP level indication.
b) HIGH HIGH Aeration Basin Sump ALARM.
c) Level Instrument Fail ALARM (for each instrument)

b. Software Interlock:
   1) The blower shall also stop on the following conditions:
      a) Aeration Blower
         (1) Aeration Blower FAIL.
         (2) Aeration Blower FAIL TO RESPOND.

c. Alarms Generated by SCADA:
   1) SCADA shall alarm on Excessive Starts per Hour. Initially Excessive Starts per Hour shall be set at 6 starts per hour (0-12 starts per hour).

G. Special Considerations:
   1. Power outage and restore operation.
      a. During power outages, the blower with associated valves and filters will not operate due to loss of power. The blower alarms will be de-activated at SCADA during power outages. Upon restoration of the power, blower and associated equipment shall resume normal operation (pump and valves called based on the sequence of operation) to fill Water Storage Tank. Alarms will be re-activated at SCADA upon restoration of power.

3.03 RAW WATER BOOSTER PUMP STATION (20MH)

A. References:
   1. Process Area: Methane Treatment.
   2. P&ID Drawing: P3.
   3. Mechanical Drawings: M301.
   4. Specification Sections: 11302.

B. Mechanical Equipment:

Tag Number	Equipment Name
20MH-P203	Raw Water Booster Pump 1
20MH-P207	Raw Water Booster Pump 2

C. General Description:
   1. The 4MG Water Storage Tank will either be filled from SYSTEM PRESSURE or from WELL 165 PUMP. A SCADA/OIS STORAGE TANK FILL Selector switch shall be provided to select between the two methods to fill the Tank.
      a. There will also be a SCADA/OIS Selector switch TIME OF DAY Mode option for WELL 165 PUMP. If this mode is ENABLED, the Well Pump will be prevented from operating between a START TIME (adjustable) and STOP TIME (adjustable) TIME OF DAY. If the mode is DISABLED, the Well pump will be called when necessary. If the Well Pump is DISABLED in this mode, the Raw Water Booster Pumps will also be DISABLED.
      b. There will also be an EMERGENCY FILL MODE – Regardless of Water Storage Tank operational mode, if the System (discharge) pressure 60FW-PIT061 is less than the Emergency START PRESSURE setpoint (adjustable) and the Water Storage Tank level 51ST-LIT050 is less than a START LEVEL setpoint (adjustable), call Well pump and Raw Water Booster Pumps to start.
   2. The Raw Water Booster Pumps operate during SYSTEM PRESSURE mode and EMERGENCY mode; will eventually shut down on lockouts if both filter are not operating (either Filtering or Backwashing).

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) Raw Water Booster Pump 1
            a) High Discharge Pressure switch (20MH-PSH203).
            b) P203 Discharge Pressure (20MH-PIT031)
         2) Raw Water Booster Pump 2
            a) High Discharge Pressure switch (20MH-PSH207).
            b) P207 Discharge Pressure (20MH-PIT041)
         3) Methane Treatment System.
            a) Ultrasonic type level transducer (20MH-LT030).
            b) Low Low Level Switch (20MH-LSLL016)
         4) Backwash Recycle Tank.
            a) High High Level Switch (40BK-LSHH036)
         5) Water Storage Tank.
            a) High High Level Switch (50ST-LSHH066)
   2. Local Control Panel:
      a. Control Devices:
         1) None
      b. Indicators and Alarms:
         1) None

E. MCC Controls and Instrumentation:
   1. MCC Panels:
      a. MCC Control Devices.
         1) LOCAL/OFF/REMOTE selector switch.
         2) Control Power (CP) ON/OFF selector switch.
         3) VFD (Variable Frequency Drive Starter) RESET pushbutton.
         4) HI PRESSURE RESET pushbutton.
      b. Indicators and Alarms: (Typical for each pump)
         1) READY indication.
         2) READY status for Raw Water Booster Pump. Raw Water Booster Pump is READY under the following conditions:
            a) The equipment is in REMOTE.
            b) The CPT is active.
            c) The hardwired High Discharge Pressure Switch is not active.
            d) The hardwired Methane Sump Lo Lo level switch is not active.
            e) The hardwired P203 (P207) High pressure switch is not active
            f) The hardwired Recycled Water Tank High High level switch is not active
            g) The hardwired Water Storage Tank High High level switch is not active
            h) There is not an active VFD starter FAIL alarm.
         3) RUN indication.
         4) RUN status for Raw Water Booster Pump.
         5) FAIL indication.
         6) FAIL ALARM for Raw Water Booster Pump.
      c. Hardwired Interlocks: (Typical for each pump)
         1) In both the LOCAL and REMOTE modes, when the Raw Water Booster Pump is called to start, OPEN the Pre-Lube water solenoid valve prior to starting the pump.

2) A High Pressure switch is hardwired to shutdown the pump to prevent operation if the discharge pressure is above the High pressure switch setpoint. The High Pressure switch also provides an alarm to the PLC. This alarm requires a MANUAL reset with a pushbutton at the MCC.
3) A Low-Low Level switch is hardwired to shutdown the pump to prevent operation if the Methane sump level is below the Low-Low Level setpoint. The Low-Low Level switch also provides an alarm to the PLC.
4) A High-High Level switch is hardwired to shutdown the pump to prevent operation if the Backwash Recycle Tank level is above the High-High Level setpoint. The High-High Level switch also provides an alarm to the PLC.
5) A High-High Level switch is hardwired to shutdown the pump to prevent operation if the Water Storage Tank level is above the High-High Level setpoint. The High-High Level switch also provides an alarm to the PLC.

F. PLC/OIS Functions:
1. Control:
a. General (Typical for each Pump)
1) RUN and READY status of the Raw Water Booster Pump are transmitted from the MCC to SCADA for indication.
2) SCADA shall accumulate Raw Water Booster Pump run time for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, previous 14 days, month to date, and previous calendar month.
3) AUTO/MANUAL switch shall be provided in SCADA for Raw Water Booster Pump.
4) A START/STOP switch shall be available for manual control of the pump from SCADA.
b. SCADA Manual Control Mode
1) If the Raw Water Booster Pump is not in REMOTE, then SCADA shall indicate it is NOT IN REMOTE.
2) When LOCAL/ OFF/ REMOTE selector switch for Raw Water Booster Pump is in REMOTE position and IN SERVICE, the Operator may place the Raw Water Booster Pump in MANUAL and start and stop the Raw Water Booster Pump from SCADA, which will operate the Raw Water Booster Pump until the Operator changes the operation.
c. SCADA Automatic Control Mode
1) When LOCAL/ OFF/ REMOTE for Raw Water Booster Pump is in REMOTE and IN SERVICE and the STORAGE TANK FILL SCADA/OIS switch is in WELL 165 PUMP or the station is in EMERGENCY FILL MODE, starting and stopping of the Raw Water Booster Pumps shall be based on the level in the Water Storage Tank.
2) If the Water Storage Tank is less than a START setpoint (adjustable) after an adjustable time delay, then call both Raw Water Booster Pumps to operate. Pumps shall modulate to maintain a desired level (5.5 ft adjustable).

3) If the Water Storage Tank is greater than an adjustable STOP setpoint after an adjustable time delay, then remove the pump call to stop the Raw Water Booster Pump.

2. Screen Indicators and Alarms at PLC/OIS:
   a. System:
      1) Raw Water Booster Pump: (typical for both pumps)
         a) STORAGE TANK FILL mode indication
         b) Raw Water Booster Pump P203 (P207) Discharge Pressure Indication.
         c) SPEED indication.
         d) RUN indication.
         e) Run time meter: SCADA shall accumulate total pump run time and starts for each pump for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, current week, month to date, previous calendar month and total runtime
         f) READY status: The status shall be transmitted to SCADA when a common alarm is not activated, the local selector switch is in REMOTE position, the pump is ready to run and the following alarm conditions are not active:
            (1) The hardwired High Discharge Pressure Switch is not active.
            (2) The hardwired Methane Sump Low Low level switch is not active.
            (3) The hardwired Backwash Recycle Tank High High level switch is not active.
            (4) The Water Storage Tank High High level switch is not active
            (5) There is not an active VFD FAIL alarm.
         g) COMMON FAIL ALARM: An alarm shall be transmitted to SCADA for motor overload, pump fail, high discharge pressure, and excessive starts per hour.
         h) Raw Water Booster Pump OUT OF SERVICE status.
         i) Raw Water Booster Pump FAIL TO RESPOND ALARM indication.
         j) HIGH Raw Water Booster Pump P203 (P207) discharge pressure (switch) ALARM.
         k) HIGH Raw Water Booster Pump P203 (P207) discharge pressure ALARM
         l) LOW Raw Water Booster Pump P203 (P207) discharge pressure ALARM (only if associated pump is running)
      2) Water Levels:
         a) AERATION BASIN SUMP level indication.
         b) LOW LOW Aeration Basin Sump ALARM.
         c) HIGH AERATION BASIN SUMP level ALARM
         d) LOW AERATION BASIN SUMP level ALARM
         e) BACKWASH RECYCLE TANK level indication.
         f) HIGH HIGH Backwash Recycle Tank ALARM.
         g) WATER STORAGE TANK level indication.
         h) HIGH HIGH Water Storage Tank ALARM.
         i) Level Instrument Fail ALARM (for each instrument)

b. Software Interlock:
   1) The pump shall also stop on the following conditions: (typical)
      a) Raw Water Booster Pump
         (1) Raw Water Booster Pump FAIL.
         (2) Raw Water Booster Pump FAIL TO RESPOND.
         (3) HIGH Raw Water Booster Pump (pressure switch) discharge pressure ALARM.
         (4) Only one Raw Water Booster Pump is running or other pump has shutdown on pump FAIL or FAIL TO RESPOND.
      b) Methane Removal
         (1) LOW LOW Methane Sump level ALARM.
      c) Filters
         (1) Any FIILTER VALVE FAIL ALARM– requires local reset at HMI
         (2) Signal FAIL for any Filter influent flowmeter
      d) Water Storage Tank
         (1) HIGH HIGH Water Storage Tank level ALARM.
      e) Chemical System
         (1) LOW CL2 residual post filter ALARM.
         (2) HIGH HIGH CL2 residual post filter ALARM.
         (3) LOW CL2 residual Treated Water Pump Station ALARM.
         (4) HIGH HIGH CL2 residual Treated Water Pump Station ALARM.
         (5) CL2 Cylinders de-energized
         (6) LOW fluoride residual ALARM.
         (7) Fluoride Unit FAIL ALARM.
         (8) HIGH HIGH CL2 Chlorine gas leak ALARM.
      f) FILTER BACKWASH FAIL ALARM – requires local reset at HMI
         (1) High Backwash flow alarm.
         (2) High Filter rinsing flow alarm.
      g) BACKWASH RECYCLING ALARM– requires local reset at HMI
         (1) Backwash Recycle valve FAIL
         (2) Signal FAIL for Backwash Recycle flowmeter
         (3) Signal FAIL for the Backwash Recycle Tank level transmitter (40GW-LIT40)
         (4) HIGH Backwash Recycle flow ALARM.
         (5) HIGH HIGH Backwash Recycle Tank ALARM.
c. Alarms Generated by SCADA:
   1) SCADA shall alarm on Excessive Starts per Hour. Initially Excessive Starts per Hour shall be set at 6 starts per hour (0-12 starts per hour).

G. Special Considerations:
   1. Power outage and restore operation.
      a. During power outages, the pump with associated valves and filters will not operate due to loss of power. The alarms will be de-activated at SCADA during power outages. Upon restoration of the power, pump and associated equipment shall resume normal operation (pump and valves called based on the sequence of operation) to fill Water Storage Tank. Alarms will be re-activated at SCADA upon restoration of power.

3.04 MANGANESE FILTERS (31MT)

A. References:
   1. Process Area: Filters.
   2. P&ID Drawing: P4 through P6.
   3. Mechanical Drawings: M401.
   4. Specification Sections: 13202.

B. Mechanical Equipment:

Tag Number	Equipment Name
31MT-MOV_02	Filter Influent Valve
31MT-MOV_04	Filter Cell 1 Influent Valve
31MT-MOV_06	Filter Cell 1 Backwash Valve
31MT-MOV_08	Filter Cell 2 Influent Valve
31MT-MOV_10	Filter Cell 2 Backwash Valve
31MT-MOV_12	Filter Cell 3 Influent Valve
31MT-MOV_14	Filter Cell 3 Backwash Valve
31MT-MOV_16	Filter Rinse Valve
31MT-MOV_18	Filter Effluent Valve
31MT-MOV452	Filter 3 Influent Valve
31MT-MOV454	Filter 3 Cell 1 Influent Valve
31MT-MOV456	Filter 3 Cell 1 Backwash Valve
31MT-MOV458	Filter 3 Cell 2 Influent Valve
31MT-MOV450	Filter 3 Cell 2 Backwash Valve
31MT-MOV462	Filter 3 Cell 3 Influent Valve
31MT-MOV464	Filter 3 Cell 3 Backwash Valve
31MT-MOV466	Filter 3 Rinse Valve
31MT-MOV468	Filter 3 Effluent Valve
20MH-P203	Raw Water Booster Pump 1
20MH-P207	Raw Water Booster Pump 2

_ represents:
   3 for Filter 1
   4 for Filter 2

C. General Description:
   1. Two manganese filters are provided with this project with provisions for a future third filter. Water from the Methane Sump is pumped through the Filters to the Water Storage Tank. Nine valves for each Filter are used to control Filter operation. Each filter has three cells, each cell has its own individual influent valve and backwash valve. Each Filter has a differential pressure (headloss) transmitter and influent flow meter.
   2. Each Filter has associated with it nine motor actuated valves. All the valves have an OPEN/CLOSE (spring return to center) selector switch and LOCAL/STOP/REMOTE local interface. In addition, the Filter Influent Valve can be modulated by the PLC to maintain the setpoint filter flow. The valves are as follows:
      a. Filter Influent Valve
      b. Filter Cell 1 Influent Valve
      c. Filter Cell 1 Backwash Valve
      d. Filter Cell 2 Influent Valve
      e. Filter Cell 2 Backwash Valve

f. Filter Cell 3 Influent Valve
g. Filter Cell 3 Backwash Valve
h. Filter Rinse Valve
i. Filter Effluent Valve

3. The filters will operate in one of three modes: Filter, Backwash and Rinse to Waste.
   a. Filter Mode is normal operation. The filters shall always be in Filter mode unless they are in Backwash Mode, Rinse Mode, or Offline.
   b. Backwash Mode – Backwash is initiated by either “Time in Operation”, or Manual.
   c. “Rinse to Waste” Mode completes the Backwash operation before the filter is placed back in Filter Mode.
   d. When a filter is Offline, all filter valves shall be closed and remain closed. Filters shall be placed Offline when Well Pump and Raw Water Booster Pumps are Off or when Water Storage Tank Fill status is not in “Well Pump” mode.
4. In normal filter operation the valves are controlled as follows:
   a. The filters shall be initially be placed in Filter mode when Raw Water Booster Pump are started.
   b. The following valves are OPEN for the respective filter in Filter Mode:
      1) Filter 1:
         a) Influent Valve (MOV302) (Modulating)
         b) Cell 1 Influent Valve (MOV304)
         c) Cell 2 Influent Valve (MOV308)
         d) Cell 3 Influent Valve (MOV312)
         e) Effluent Valve (MOV318)
      2) Filter 2:
         a) Influent Valve (MOV402) (Modulating)
         b) Cell 1 Influent Valve (MOV404)
         c) Cell 2 Influent Valve (MOV408)
         d) Cell 3 Influent Valve (MOV412)
         e) Effluent Valve (MOV418)
      3) Filter 3: (Future)
         a) Influent Valve (MOV452) (Modulating)
         b) Cell 1 Influent Valve (MOV454)
         c) Cell 2 Influent Valve (MOV458)
         d) Cell 3 Influent Valve (MOV462)
         e) Effluent Valve (MOV468)
   c. The following valves are CLOSED for the respective filter in Filter Mode:
      1) Filter 1:
         a) Cell 1 Backwash Valve (MOV306)
         b) Cell 2 Backwash Valve (MOV310)
         c) Cell 3 Backwash Valve (MOV314)
         d) Rinse Valve (MOV316)
      2) Filter 2:
         a) Cell 1 Backwash Valve (MOV406)
         b) Cell 2 Backwash Valve (MOV410)
         c) Cell 3 Backwash Valve (MOV414)
         d) Rinse Valve (MOV416)
      3) Filter 3 (Future):
         a) Cell 1 Backwash Valve (MOV456)

b) Cell 2 Backwash Valve (MOV460)
c) Cell 3 Backwash Valve (MOV464)
d) Rinse Valve (MOV466)

d. The following valves are to MODULATE for the respective filter in Filter Mode to prevent the filter from exceeding its “Maximum Flow Rate”:
   1) Filter 1 Influent Valve (MOV302) shall modulate based on Filter 1 MAXIMUM FILTER FLOW setpoint __ gpm (adjustable).
   2) Filter 2 Influent Valve (MOV402) shall modulate based on Filter 2 MAXIMUM FILTER FLOW setpoint __ gpm (adjustable).
   3) Filter 3 Influent Valve (MOV452) shall modulate based on Filter 3 MAXIMUM FILTER FLOW setpoint __ gpm (adjustable). (FUTURE)
   4) The influent modulating valves shall typically be fully open unless valve modulates down to its “Maximum Flow Rate” (desired flow setpoint).

5. Backwash Mode Operation:
   a. Only one filter may be backwashed at a time. The filter not being backwashed shall remain in Filter mode since all filters are always in Filter mode unless they are in Backwash Mode, Rinse to Waste Mode.
   b. Backwash Mode – Backwash is initiated by either “Time in Operation” or Manual.
      1) Time - There is a separate timer for each filter while it is in Operation. After ###.# hours (adjustable) in Filter Mode operation, the Filter will automatically start the Backwash Cycle.
      2) Manual – The operator may manually initiate the backwash of an individual filter by pressing a pushbutton on the SCADA OIT or local HMI. This will automatically reset the Backwash Cycle.
      3) Backwash Recycle Tank availability:
         a) The Backwash Recycle Tank has been sized to permit one filter to be backwashed between backwash recycling events.
         b) Inhibit Backwash Initiation if the level in the Backwash Recycle Tank is greater than “inhibit” setpoint 4.5’ initial (adjustable) as detected by LIT040, inhibit the Backwash from starting, continue in Filter Mode and generate an alert for the operator that the Backwash of the specific Filter was inhibited. This level is the maximum level in the Backwash Recycle tank that will hold the water produced during the Filter Backwash and Rinse cycle.
      4) Each Filter has a differential pressure transmitter across the filter, located after the Filter Influent Valve and before the Filter Effluent Valve. The high pressure differential (adjustable) alarm will notify operator that a backwash of the specific filter may be required. This alarm does not automatically start a backwash.
      5) Filter Cell backwash order – The order that the filter cells will be backwashed may be a fixed order determined by the operator or rotate automatically after each backwash cycle.
      6) The filter being backwashed is temporarily removed from service by closing the filter effluent valve. The filter shall be backwashed at an operator set rate based on the filter influent flow meter. While in backwash, one filter cell will be backwashed at a time with the other two filter cells provides source backwash water. The cell being backwashed will have its cell influent valve closed and cell BW valve open; the other cells will have its cell influent valve open and cell BW

valves closed during the Cell Backwash Time Period to push water through its cells and out only one cell. After the lead cell has been backwashed, the lag cell shall be backwashed and Filter individual cell valves shall be adjusted accordingly. Similar for lag2 cell.

c. Cell Backwash Sequence: (Filter 1 Cell order 1-2-3, typical for any Filter cell order)
   1) Step 1 – Abandon the backwash if the Raw Water Booster pumps are not running or if the Well Pump is not running.
   2) Step 2 –
      a) Filter 1 Influent Valve (MOV302) shall modulate based on an operator adjustable Filter 1 BACKWASH FLOW setpoint.
      b) Filter 2 Influent Valve (MOV402) shall modulate based on an operator adjustable Filter 2 FILTER FLOW setpoint. (It is still in Filter Mode)
      c) Filter 3 Influent Valve (MOV452) shall modulate based on an operator adjustable Filter 3 FILTER FLOW setpoint. . (It is still in Filter Mode) (FUTURE)
   3) Step 3 –
      a) Close Filter 1 Effluent Valve (MOV318)
      b) Filter 2 Effluent Valve (MOV418) to remain open
      c) Filter 3 (Future) Effluent Valve (MOV468) to remain open
   4) Step 4 –
      a) Open Filter 1 Cell 1 Backwash Valve (MOV306) and close Filter 1 Cell 1 Influent Valve (MOV304)
      b) Filter 1 Cell 2 Influent Valve (MOV308) and Filter 1 Cell 3 Influent Valve (MOV312) to remain open
      c) Filter 1 Cell 2 Backwash Valve (MOV310) and Filter 1 Cell 3 Backwash Valve (MOV314) to remain closed
      d) Steps 3 & 4 shall occur simultaneously to backwash Cell 1.
   5) Step 5 – Filter Cell 1 to be backwashed for an adjustable Cell Backwash time.
   6) Step 6 –
      a) Close Filter 1 Cell 1 Backwash Valve (MOV306) and open Filter 1 Cell 1 Influent Valve (MOV304)
      b) Open Filter 1 Cell 2 Backwash Valve (MOV310) and close Filter 1 Cell 2 Influent Valve (MOV308)
      c) Filter 1 Cell 3 Influent Valve (MOV312) to remain open and Filter 1 Cell 3 Backwash Valve (MOV314) to remain closed
   7) Step 7 – Filter Cell 2 to be backwashed similar to Step 5 (Cell 1).
   8) Step 6 –
      a) Filter 1 Cell 1 Influent Valve (MOV304) to remain open and Filter 1 Cell 1 Backwash Valve (MOV306) to remain closed
      b) Close Filter 1 Cell 2 Backwash Valve (MOV310) and open Filter 1 Cell 2 Influent Valve (MOV308)
      c) Open Filter 1 Cell 3 Backwash Valve (MOV314) and close Filter 1 Cell 3 Influent Valve (MOV312)
   9) Step 7 – Filter Cell 3 to be backwashed similar to Step 5 (Cell 1).
   10) Rinse cycle follows the completion of the last cell backwashed.

d. Utility Power Failure during Backwash- upon utility power restoration, the backwash cycle will be abandoned and the Operator shall be notified of this status.

e. Rinse to Waste Mode –Rinse to Waste occurs after all filter cells have been backwashed or if Backwash has been abandoned.
   1) Continuing from Step 7 of Backwash Mode (Filter 1, typical for all filters)
   2) Step 8 –
      a) Filter 1 Influent Valve (MOV302) shall modulate based on an operator adjustable Filter 1 RINSE FLOW setpoint.
      b) Filter 2 Influent Valve (MOV402) shall modulate based on an operator adjustable Filter 2 FILTER FLOW setpoint. (It is still in Filter Mode)
      c) Filter 3 Influent Valve (MOV452) shall modulate based on an operator adjustable Filter 3 FILTER FLOW setpoint. . (It is still in Filter Mode) (FUTURE)
   3) Step 9 –
      a) Open Filter 1 Rinse Valve (MOV316)
      b) Filter 1 Cell 1 Influent Valve (MOV304) to remain open and Filter 1 Cell 1 Backwash Valve (MOV306) to remain closed
      c) Filter 1 Cell 2 Influent Valve (MOV304) to remain open and Filter 1 Cell 2 Backwash Valve (MOV306) to remain closed
      d) Close Filter 1 Cell 3 Backwash Valve (MOV314) and open Filter 1 Cell 3 Influent Valve (MOV312)
   4) Step 10 – Filter 1 to be rinsed for an adjustable Filter Rinse time.
   5) Step 11 –
      a) Close Filter 1 Rinse Valve (MOV316)
      b) Open Filter 1 Effluent Valve (MOV318)
      c) Filter 1 Influent Valve (MOV302) shall modulate based on an operator adjustable Filter 1 FILTER FLOW setpoint.
      d) Rinse Cycle has completed – Place Filter 1 back in Filter Mode.
      e) If the most recent backwash cycle prior to the Rinse Cycle was not abandoned then reset “Filter 1 in Operation” Timer (Typical for other Filters), otherwise do not reset the Timer.

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) Differential Pressure Transmitter (each filter).
         2) Filter Influent Flowmeter (each filter).
   2. Local Control Panel:
      a. Control Devices:
         1) LOCAL/STOP/REMOTE Selector switch (Each valve).
         2) OPEN/CLOSE (spring return to center) Selector switch (Each valve).
      b. Indicators and Alarms:
         1) None
      c. Logic:
         1) Local Manual Mode:
            a) Local Manual control of each filter valve is performed by using the LOCAL/STOP/REMOTE selector switch and the OPEN/CLOSE (spring return to center) Selector switch located at the valve operator. OPENED and CLOSED status of each valve is indicated at the valve operator.

2) Local Remote Mode:
   a) None.

E. MCC Controls and Instrumentation:
1. MCC Panels:
   a. MCC Control Devices.
      1) None
   b. Indicators and Alarms:
      1) None
   c. Hardwired Interlocks:
      1) None

F. PLC/OIS Functions:
1. Control:
   a. SCADA Manual Control Mode
      1) When LOCAL/STOP/REMOTE selector switch for valves is in REMOTE position and IN SERVICE, the Operator may control the Filter in a Manual or Automatic mode. In the Manual mode, the Operator may open, close or position the filter valves.
      2) OPEN and CLOSE status of each Valve is transmitted to the SCADA system for indication. When the LOCAL/STOP/REMOTE switch at the Valve is in REMOTE and IN SERVICE the Operator can OPEN or CLOSE the Valves from SCADA. REMOTE operation status of each Valve is transmitted to the SCADA system for indication. If a Valve is not in READY, then SCADA shall indicate it is NOT IN READY.
   b. SCADA Automatic Control Mode
      1) In the Automatic mode, the SCADA system shall modulate the Filter Influent Valve to maintain a Methane Sump adjustable level setpoint. Filter RUN TIME, HEADLOSS, WATER STORAGE TANK LEVEL, and BACKWASH RECYCLE TANK LEVEL shall be displayed on the Operator Workstation. All the Valves must be in SCADA Automatic mode for the automatic controls to function.
      2) If the Water Storage Tank is less than an adjustable STOP setpoint and the Raw Water Booster Pumps are running, the filters shall operate as described above in Part C – General Description.
      3) If the Water Storage Tank is greater than an adjustable STOP setpoint after an adjustable time delay, then close all filter valves.
2. Screen Indicators and Alarms at PLC/OIS:
   a. System
      1) Valve FAIL of each valve is transmitted to the SCADA system for indication
      2) All valve remote, valve position status, % open, % control, fail, and Out-Of-Service status
      3) All Filter Influent Flow indication, include space for future
      4) All Filter Differential pressure indication, include space for future
      5) All Filter Manual Backwash Pushbuttons
      6) Filter Run time meter: SCADA shall accumulate total filter run time since last backwash
      7) Backwash Recycle Tank level indication
      8) Backwash Recycle Tank – Inhibit Backwash level setpoint

9) Backwash Recycle Tank – Abandon Backwash go to Rinse level setpoint
10) Filters can be placed in “OUT OF SERVICE” when it is in PCIS OFF or when any valve is “NOT READY” input to PLC. Filters will then be:
    a) Will block all Filter alarms
    b) HMI display will cover Filters with text “OUT OF SERVICE” “OOS”
    c) Well Pump will shut down
    d) Raw Water Booster Pump will shut down.
    e) Filter Influent and Effluent Valves will close.
    f) Backwash Recycle Valve will close

b. Software Interlock:
    1) The filter valves shall close on the following conditions:
        a) Raw Water Booster Pump
            (1) Only one Raw Water Booster Pump is running or other pump has shutdown on pump FAIL or FAIL TO RESPOND.
        b) Filters
            (1) Any FIILTER VALVE FAIL ALARM– requires local reset at HMI
            (2) Signal FAIL for any Filter influent flowmeter
            (3) High Filter Flow Alarm– requires local reset at HMI
        c) Water Storage Tank
            (1) HIGH HIGH Water Storage Tank level ALARM.
        d) FILTER BACKWASH FAIL ALARM – requires local reset at HMI
            (1) High Backwash flow alarm.
            (2) High Filter rinsing flow alarm.
        e) BACKWASH RECYCLING ALARM– requires local reset at HMI
            (1) Backwash Recycle valve FAIL
            (2) Signal FAIL for Backwash Recycle flowmeter
            (3) Signal FAIL for the Backwash Recycle Tank level transmitter (40GW-LIT40)
            (4) HIGH Backwash Recycle flow ALARM.
            (5) HIGH HIGH Backwash Recycle Tank ALARM.

c. Alarms Generated by SCADA:
    1) The SCADA system shall generate a Valve FAIL-TO-OPEN alarm if the Valve is called to Open at SCADA and the OPENED status is not indicated within 120 seconds (adjustable). The SCADA system shall generate a Valve FAIL-TO-CLOSE alarm if the Valve is called to Close at SCADA and the CLOSED status is not indicated within 120 seconds (adjustable). The SCADA system shall generate a Valve ILLEGAL-IO alarm if the Valve position indicates an OPENED and CLOSED status simultaneously.
    2) The SCADA system shall generate an Influent Valve FAIL TO ACHIEVE POSITION alarm if the Influent Valve is called to move and the Valve position feedback does not match Valve position setpoint within 120 seconds (adjustable). The SCADA system shall generate an Influent Valve ILLEGAL IO alarm if the Influent Valve position status to SCADA is both OPENED and CLOSED.
    3) HIGH HEADLOSS (adjustable) shall be alarmed at SCADA if the values exceed Operator adjustable setpoint values.

4) Filter Run Time shall be generated by SCADA for each individual Filter whenever the respective Effluent Valve is NOT CLOSED or the filter is in Filter-to-Waste mode. The Filter Run Time shall be reset to zero when the Influent Valve is opened following a backwash cycle.

G. Special Considerations:
1. Power outage and restore operation.
a. During power outages, the Filter Valves will not operate due to loss of power. The alarms will be de-activated at SCADA during power outages. Upon restoration of the power, Filters and associated equipment shall resume normal operation (pump and valves called based on the sequence of operation) to fill Water Storage Tank. Alarms will be re-activated at SCADA upon restoration of power.

3.05 BACKWASH RECYCLE SYSTEM (40BK)

A. References:
1. Process Area: Backwash Recycle.
2. P&ID Drawing: P7.
3. Mechanical Drawings: M501.
4. Specification Sections: 13212.

B. Mechanical Equipment:

Tag Number	Equipment Name
40BK-MOV349	Backwash Recycle Valve

C. General Description:
1. The filter Backwash Recycle Tank receives water from the filters during cell backwashing and filter rinsing. The Backwash Recycle Valve returns water to the Aeration Basin Sump for retreatment. Backwash Recycle Valve will modulate to control the return flow. This valve can be opened or closed locally or via SCADA.

D. Local Controls and Instrumentation:
1. System:
a. Instruments and Protective Devices:
1) Backwash Recycle Tank Level (40BK-LIT040)
2) Backwash Recycle Tank High High Level Switch (40BK-LSHH036)
3) Backwash Recycle Flow (40BK-FIT052)
2. Local Control Panel:
a. Control Devices:
1) LOCAL/STOP/REMOTE Switch
2) OPEN/CLOSE (spring return to center) Selector switch.
b. Indicators and Alarms:
1) None
c. Interlocks:
1) None.
d. Logic:
1) Local Manual Control Mode:
a) Local Manual control of the Valve can be performed at the Local Control Station. The Valve shall be operated locally using the

OPEN/CLOSE (spring return to center) Selector switch when the selector switch is in LOCAL.

2) Local Automatic Control Mode:
   a) None.

E. MCC Controls and Instrumentation:
1. MCC Panels:
   a. MCC Control Devices.
      1) None
   b. Indicators and Alarms:
      1) None
   c. Hardwired Interlocks:
      1) None

F. PLC/OIS Functions:
1. Control:
   a. SCADA Manual Control Mode
      1) OPENED and CLOSED status of each Valve is transmitted to the SCADA system for indication. When the LOCAL/STOP/REMOTE switch at the valve actuator control station is in REMOTE and IN SERVICE, the Operator can OPEN or CLOSE the valve from SCADA. REMOTE operation status of each valve is transmitted to the SCADA system for indication. If the valve is not in REMOTE, then SCADA shall indicate it is NOT IN REMOTE.
   b. SCADA Automatic Control Mode
      1) The Operator may enter a set recycle flow in percent (%), initially 10%. When the Well Pump is operating and the Pump to Waste Valve is CLOSED, the Backwash Recycle valve shall modulate to maintain the flow setpoint
      2) If the Backwash Recycle Tank is less than an adjustable STOP setpoint (initially 4 feet) after an adjustable time delay, then close the valve.
2. Screen Indicators and Alarms at PLC/OIS:
   a. System
      1) Valve FAIL of each valve is transmitted to the SCADA system for indication
      2) All valve remote, valve position status, % open, % control, fail, and Out-Of-Service status
      3) READY status: The status shall be transmitted to SCADA when a common alarm is not activated, the local selector switch is in REMOTE position, the pump is ready to run and the following alarm conditions are not active:
         a) There is not an active valve FAIL alarm.
      4) Well 165 Pump:
         a) Run Status
         b) Well 165 Flow
      5) Water Levels:
         a) BACKWASH RECYCLE TANK level indication.
         b) HIGH HIGH Backwash Recycle Tank ALARM.
         c) Level Instrument Fail ALARM (for each instrument)

b. Software Interlock:
   1) The valve shall also close on the following conditions:
      a) Well 165 Pump
         (1) Pump not running.
      b) Filters
         (1) Filter in Backwash or Filtering (close valve for 12 hours (adjustable) after completion of Backwash to allow tank settling.
      c) BACKWASH RECYCLING ALARM– requires local reset at HMI
         (1) Backwash Recycle valve FAIL
         (2) Signal FAIL for Backwash Recycle flowmeter
         (3) Signal FAIL for the Backwash Recycle Tank level transmitter (40GW-LIT40)
         (4) HIGH Backwash Recycle flow ALARM.
         (5) HIGH HIGH Backwash Recycle Tank ALARM.
c. Alarms Generated by SCADA:
   1) The SCADA system shall generate Backwash Recycle Valve FAIL TO ACHIEVE POSITION alarm if the Backwash Recycle Valve is called to move and the Backwash Recycle Valve position feedback does not match Valve position setpoint within 120 seconds (adjustable). The SCADA system shall generate a Backwash Recycle Valve ILLEGAL IO alarm if the Backwash Recycle Valve position status to SCADA is both OPENED and CLOSED.
   2) The SCADA system shall generate a FLOW EXCEEDS 10% alarm if the flow setpoint is greater than 10% of the system flowrate as determined by the Backwash Recycle flow setpoint.

G. Special Considerations:
   1. Power outage and restore operation.
      a. During power outages, the valve will not operate due to loss of power. The alarms will be de-activated at SCADA during power outages. Upon restoration of the power, valve shall resume normal operation. Alarms will be re-activated at SCADA upon restoration of power.

3.06 CHLORTAINER SYSTEM (81CL)

A. References:
   1. Process Area: Chlorine Room.
   2. P&ID Drawing: P8.
   3. Mechanical Drawings: M602.
   4. Specification Sections: 11260 & 11261.

B. Mechanical Equipment:

Tag Number	Equipment Name
81CL-CYL800	Chlortainer Cylinder 1
81CL-CYL801	Chlortainer Cylinder 2

C. General Description:
   1. The weigh scales output the net weight of the chlorine gas in each cylinder. Each weigh instrument shall have the ability accept the entered weight of the cylinder and subtract it from the total weight measured.
   2. The local chlorine gas leak detector 81CL-AIT033 shall generate a high alarm (0.5ppm adjustable at detector) and automatically activate the Fail Safe Actuator and Valve system to shut off the nitrogen supply system and close the chlorine cylinder valves.
   3. The auto changeover switch shall switch between the two chlorine cylinders to feed chlorine to the system. Status of switch position shall be monitored by the PLC.
   4. The narrow band chlorine gas leak detector AIT033 and shall be monitored by the PLC.
   5. The wide band chlorine gas leak detector AIT043 is for display of chlorine gas outside of chlorine room.

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) Chlorine Cylinder 1 (81CL-WIT014)
         2) Chlorine Cylinder 2 (81CL-WIT024)
         3) Chlorine Gas (81CL-AIT033)
         4) Chlorine Gas (81CL-AIT043)
   2. Local Control Panel:
      a. Control Devices:
         1) Auto changeover switch
      b. Indicators and Alarms:
         1) None
      c. Interlocks:
         1) On High High chlorine gas leak (AIT033), hardwired to close nitrogen solenoid valves for chlorine gas cylinders. CYL800 and CYL801 solenoids have been de-energized.

E. MCC Controls and Instrumentation:
   1. MCC Panels:
      a. MCC Control Devices.
         1) None
      b. Indicators and Alarms:
         1) None
      c. Hardwired Interlocks:
         1) None.

F. PLC/OIS Functions:
   1. Control:
      a. SCADA Manual Control Mode
         1) None.
      b. SCADA Automatic Control Mode
         1) On High High chlorine gas leak (AIT033)
            a) Stop Well Pump
            b) Stop Raw Water booster Pumps
            c) Stop Chlorine Feed Booster Pumps

2. Screen Indicators and Alarms at PLC/OIS:
   a. System:
      1) Chlorine Cylinder 1 weight indication
      2) LOW Chlorine Cylinder 1 weight ALARM
      3) Chlorine Cylinder 2 weight indication
      4) LOW Chlorine Cylinder 2 weight ALARM
      5) Cylinder position
      6) Chlorine Gas
      7) High Chlorine Gas ALARM
      8) Chlorine Gas analyzer Trouble ALARM
   b. Software Interlock:
      1) None.
   c. Alarms Generated by SCADA:
      1) None.

G. Special Considerations:
   1. Power outage and restore operation.
      a. None.

3.07 WELL 1 DISINFECTION SYSTEM (CHLORINE FEED SYSTEM NO. 1)(81CL)

A. References:
   1. Process Area: Chlorine Room
   2. P&ID Drawing: P8.
   3. Mechanical Drawings: M602.
   4. Specification Sections: 11260 & 11261.

B. Mechanical Equipment:

Tag Number	Equipment Name
81CL-P810	Chlorine Booster Pump 1
81CL-	Chlorine Booster Pump 1 Regulator

C. General Description:
   1. The Chlorine Booster pump 1 will deliver the chlorine solution to chlorinate at either Well 1 or Post Raw Water Booster Pumps. This requires manual local adjustment of valves and is not automated. Operator shall adjust selector switch located on Control Panel to inform PLC the location the chlorine will dose based on Operator manual valving. This switch is NOT hardwired to any valve.
   2. Chlorine Dosing:
      a. “Current Cl Dose = X.X mg/L” (2.0 initial value).
      b. “New Cl Dose = X.X mg/L” (Current Cl Dose initial value). Provide Confirm/Cancel button for new dosage.
   3. If “Chlorinate at Well 1” is selected:
      a. If Well Pump discharge flowmeter FE012 > 100 gpm (adjustable), call Chlorine Feed Booster Pump 1 to Start and control Gas Regulator Control Valve for dosing. If Well flowmeter falls at or below 100 gpm (adjustable), stop Chlorine Booster Pump 1.

b. Plant PLC shall output signal to adjust the flow rate of the Gas Regulator Control Valve to maintain selected dose based on the following analog input into the Plant PLC:
   1) Well pump discharge flowmeter
c. Plant PLC shall adjust flow rate of the Gas Regulator Control Valve for feed rate based on the following equation:

   (Cl Gas Flow Rate in lbs. per day) = (FE012 flow in gpm) * (0.01201) * (Cl Dose in mg/L) / (Cl Gas Strength/100)

4. If "Chlorinate at Raw Water Booster Station" is selected:
   a. If Filter Influent Flowmeters Filter 1 & Filter 2 sum total > 100 gpm (adjustable), call Chlorine Feed Booster Pump 1 to Start and control Gas Regulator Control Valve for dosing.
   b. Plant PLC shall output signal to adjust the flow rate of the Gas Regulator Control Valve to maintain selected dose based on the following analog input into the Plant PLC:
      1) Filter Influent flowmeters 1 & 1 sum total
   c. Plant PLC shall adjust flow rate of the Gas Regulator Control Valve for feed rate based on the following equation:

      (Cl Gas Flow Rate in lbs. per day) = (Filter influent flowmeters FE032 & FE042 Sum Total in gpm) * (0.01201) * (Cl Dose in mg/L) / (Cl Gas Strength/100)

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) None
   2. Local Control Panel:
      a. Control Devices:
         1) None
      b. Indicators and Alarms:
         1) None

E. MCC Controls and Instrumentation:
   1. MCC Panels:
      a. MCC Control Devices.
         1) LOCAL/OFF/REMOTE selector switch.
         2) Control Power (CP) ON/OFF selector switch.
      b. Indicators and Alarms:
         1) READY indication.
         2) READY status for Chlorine Booster Pump. Chlorine Booster is READY under the following conditions:
            a) The equipment is in REMOTE.
            b) The CPT is active.
            c) There is not an active FAIL alarm.
         3) RUN indication.
         4) RUN status for Chlorine Booster Pump.
         5) FAIL indication.
         6) FAIL ALARM for Chlorine Booster Pump.
      c. Hardwired Interlocks:
         1) None.

F. PLC/OIS Functions:
   1. Control:
      a. General (Typical for each Pump)
         1) RUN and READY status of the Chlorine Booster Pump are transmitted from the MCC to SCADA for indication.
         2) SCADA shall accumulate Chlorine Booster Pump run time for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, previous 14 days, month to date, and previous calendar month.
         3) AUTO/MANUAL switch shall be provided in SCADA for Chlorine Booster Pump.
         4) A START/STOP switch shall be available for manual control of the pump from SCADA.
      b. SCADA Manual Control Mode
         1) If the Chlorine Booster pump is not in REMOTE, then SCADA shall indicate it is NOT IN REMOTE.
         2) When LOCAL/ OFF/ REMOTE selector switch for Chlorine Booster Pump is in REMOTE position and IN SERVICE, the Operator may place the Chlorine Booster pump in MANUAL and start and stop the Raw Water Booster Pump from SCADA, which will operate the Chlorine Booster Pump until the Operator changes the operation.
      c. SCADA Automatic Control Mode
         1) When LOCAL/ OFF/ REMOTE for Chlorine Booster Pump is in REMOTE and IN SERVICE starting and stopping of the Chlorine Booster Pumps shall be based on Well pump operation.
   2. Screen Indicators and Alarms at PLC/OIS:
      a. System
         1) Manual Valving arrangement)
            a) “Chlorinate at Well 1”
            b) “Off”
            c) “Chlorinate at Raw Water Booster Station”
         2) Current Chlorine Dose = X.XX mg/L
         3) Chlorine Gas Flow Rate = XXX.X ppd (calculated)
         4) Well Pump flow indication
         5) Gas Regulator Control Valve 1 Feedback indication.
         6) Gas Regulator Control Valve 1 Setpoint indication.
         7) Chlorine Booster Pump 1
            a) RUN indication.
            b) Run time meter: SCADA shall accumulate total pump run time and starts for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, current week, month to date, previous calendar month and total runtime
            c) READY status: The status shall be transmitted to SCADA when a common alarm is not activated, the local selector switch is in REMOTE position, the pump is ready to run and the following alarm conditions are not active:
               (1) There is not an active FAIL alarm.
            d) COMMON FAIL ALARM: An alarm shall be transmitted to SCADA for motor overload, pump fail, and excessive starts per hour.
            e) Pump OUT OF SERVICE status.

f) FAIL TO RESPOND ALARM indication.

8) Cylinder Position status
9) Chlortainer 1 weight
10) Chlortainer 1 LOW Weight Alarm
11) Chlortainer 2 weight
12) Chlortainer 2 LOW Weight Alarm
13) Chlorine gas indication
14) High Chlorine gas Alarm

b. Software Interlock:
1) Chlorine Booster Pump shall stop on the following conditions:
a) Three position switch is in “OFF”
b) HIGH Chlorine Gas ALARM
c) Gas Regulator Control Valve 1 is CLOSED
2) If “Chlorinate at Raw Water Booster Station” is selected
a) If the Well flowmeter is greater than a START setpoint (adjustable) after an adjustable time delay, then call Chlorine Booster Pump 1 to operate. Pumps shall modulate as described above.
b) If the Well flowmeter is less than an adjustable STOP setpoint after an adjustable time delay, then remove the pump call to stop the Chlorine Booster Pump 1 and close Gas Regulator Control Valve 1. The pump shall also stop on the following conditions:

c. Alarms Generated by SCADA:
1) The SCADA system shall generate a Regulator Valve FAIL TO ACHIEVE POSITION alarm if the Regulator Valve is called to move and the Valve position feedback does not match Valve position setpoint within 120 seconds (adjustable).

G. Special Considerations:
1. Power outage and restore operation.
a. During power outages, the pump with associated valves will not operate due to loss of power. The alarms will be de-activated at SCADA during power outages. Upon restoration of the power, pump and associated equipment shall resume normal operation. Alarms will be re-activated at SCADA upon restoration of power.

3.08 TWPS DISINFECTION SYSTEM (CHLORINE FEED SYSTEM NO. 2)(82CL)

A. References:
1. Process Area: Chlorine Room
2. P&ID Drawing: P8.
3. Mechanical Drawings: M602.
4. Specification Sections: 11260 & 11261.

B. Mechanical Equipment:

Tag Number	Equipment Name
81CL-P830	Chlorine Booster Pump 2
81CL-	Chlorine Booster Pump 2 Regulator

C. General Description:
   1. The Chlorine Booster pump 2 will deliver the chlorine solution to chlorinate upstream of flowmeter vault.
   2. Chlorine Dosing:
      a. “Current Treated Water BPS Cl Residual = X.X mg/L”. (AIT063)
      b. “Target Treated Water BPS Cl Residual = X.X mg/L”.
      c. “Current Cl Dose = X.X mg/L”. This value is based on the following equation:
         (Cl Dose in mg/L) = (Target Cl Residual in mg/L) – (Current Cl Residual in mg/L)
      d. If any Booster Pump is running and Treated Water flowmeter FE092 > 100 gpm (adjustable), call Chlorine Feed Booster Pump 2 to Start and control Gas Regulator Control Valve 2 for dosing. If flowmeter falls at or below 100 gpm (adjustable), stop Chlorine Booster Pump 2.
      e. Plant PLC shall output signal to adjust the flow rate of the Gas Regulator Control Valve to maintain selected dose based on the following analog input into the Plant PLC:
         1) Treated Water flowmeter
      f. Plant PLC shall adjust flow rate of the Gas Regulator Control Valve for feed rate based on the following equation:
         (Cl Gas Flow Rate in lbs. per day) = (FE092 flow in gpm) * (0.01201) * (Cl Dose in mg/L) / (Cl Gas Strength/100)
      g. PLC shall obtain the value for “Current Cl Residual” 150 seconds prior to performing the calculation, and the value for “Current Cl Residual” shall be updated in the calculation once every 30 seconds. If oldest/first obtainable value for “Current Cl Residual” is less than 150 seconds old, the oldest/first obtainable value shall be used until value history greater than or equal to 150 seconds.

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) None
   2. Local Control Panel:
      a. Control Devices:
         1) None
      b. Indicators and Alarms:
         1) None

E. MCC Controls and Instrumentation:
   1. MCC Panels:
      a. MCC Control Devices.
         1) LOCAL/OFF/REMOTE selector switch.
         2) Control Power (CP) ON/OFF selector switch.
      b. Indicators and Alarms:
         1) READY indication.
         2) READY status for Chlorine Booster Pump. Chlorine Booster is READY under the following conditions:
            a) The equipment is in REMOTE.
            b) The CPT is active.
            c) There is not an active FAIL alarm.

3) RUN indication.
4) RUN status for Chlorine Booster Pump.
5) FAIL indication.
6) FAIL ALARM for Chlorine Booster Pump.

c. Hardwired Interlocks:
1) None.

F. PLC/OIS Functions:
1. Control:
a. General (Typical for each Pump)
1) RUN and READY status of the Chlorine Booster Pump are transmitted from the MCC to SCADA for indication.
2) SCADA shall accumulate Chlorine Booster Pump run time for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, previous 14 days, month to date, and previous calendar month.
3) AUTO/MANUAL switch shall be provided in SCADA for Chlorine Booster Pump.
4) A START/STOP switch shall be available for manual control of the pump from SCADA.

b. SCADA Manual Control Mode
1) If the Chlorine Booster pump is not in REMOTE, then SCADA shall indicate it is NOT IN REMOTE.
2) When LOCAL/ OFF/ REMOTE selector switch for Chlorine Booster Pump is in REMOTE position and IN SERVICE, the Operator may place the Chlorine Booster pump in MANUAL and start and stop the Pump from SCADA, which will operate the Chlorine Booster Pump until the Operator changes the operation.

c. SCADA Automatic Control Mode
1) When LOCAL/ OFF/ REMOTE for Chlorine Booster Pump is in REMOTE and IN SERVICE starting and stopping of the Chlorine Booster Pumps shall be based on Booster pump operation.
2) If any Booster Pump is running and Treated Water flowmeter is greater than a START setpoint (adjustable) after an adjustable time delay, then call Chlorine Booster Pump 2 to operate. Pumps shall modulate as described above.
3) If the any Booster Pump is running and the Treated Water flowmeter is less than an adjustable STOP setpoint after an adjustable time delay, then remove the pump call to stop the Chlorine Booster Pump 2 and close Gas Regulator Control Valve 2.

2. Screen Indicators and Alarms at PLC/OIS:
a. System
1) Current Chlorine Dose = X.XX mg/L
2) Chlorine Gas Flow Rate = XXX.X ppd (calculated)
3) Upon change in Chlorine dosage setpoint, display “WARNING! Approximate 2 to 4 minute lag time exists between Chlorination Boost at TWBPS dose change and reading at analyzer, and only when TWBPS pump(s) is (are) running.”
4) Treated Water (FI092) flow indication
5) Gas Regulator Control Valve 2 Feedback indication.
6) Gas Regulator Control Valve 2 Setpoint indication.

7) Chlorine Booster Pump 2
   a) RUN indication.
   b) Run time meter: SCADA shall accumulate total pump run time and starts for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, current week, month to date, previous calendar month and total runtime
   c) READY status: The status shall be transmitted to SCADA when a common alarm is not activated, the local selector switch is in REMOTE position, the pump is ready to run and the following alarm conditions are not active:
      (1) There is not an active FAIL alarm.
   d) COMMON FAIL ALARM: An alarm shall be transmitted to SCADA for motor overload, pump fail, and excessive starts per hour.
   e) Pump OUT OF SERVICE status.
   f) FAIL TO RESPOND ALARM indication.
8) Cylinder Position status
9) Chlortainer 1 weight
10) Chlortainer 1 LOW Weight Alarm
11) Chlortainer 2 weight
12) Chlortainer 2 LOW Weight Alarm
13) Chlorine gas indication
14) High Chlorine gas Alarm

b. Software Interlock:
   1) Chlorine Booster Pump 2 shall stop on the following conditions:
      a) HIGH Chlorine Gas ALARM
      b) Gas Regulator Control Valve 2 is CLOSED

c. Alarms Generated by SCADA:
   1) The SCADA system shall generate a Regulator Valve FAIL TO ACHIEVE POSITION alarm if the Regulator Valve is called to move and the Valve position feedback does not match Valve position setpoint within 120 seconds (adjustable).

G. Special Considerations:
   1. Power outage and restore operation.
      a. During power outages, the pump with associated valves will not operate due to loss of power. The alarms will be de-activated at SCADA during power outages. Upon restoration of the power, pump and associated equipment shall resume normal operation. Alarms will be re-activated at SCADA upon restoration of power.

3.09 FLUORIDE FEED SYSTEM (83fL)

A. References:
   1. Process Area: Fluoride Room
   2. P&ID Drawing: P9.
   3. Mechanical Drawings: M602.
   4. Specification Sections: 11270.

B. Mechanical Equipment:

Tag Number	Equipment Name
83FL-PNL849	Fluoride System Panel

C. General Description:

1. Fluoride Skid contains the fluoride storage tanks, water supply solenoid, metering pump and control panel. The PLC calls the Fluoride system to operate, provides a pacing signal and monitors nigh containment level, pump run status and pump fail.
2. Fluoride Dosing:
   a. Target Fluoride Residual = X.XX mg/L (0.80 initial value)
   b. Natural Fluoride Residual = X.XX mg/L (0.48 initial value)
   c. Fluoride Pump Stroke Frequency at Calibration = XX.X% (100% initial value)
   d. Fluoride Pump Capacity at Calibration = X.XX gph (4.80 initial value)
   e. Plant PLC shall increase or decrease the stroke frequency of Fluoride metering pump by a maximum trim adjustment amount of 100% +/- 20%, based on the Current Fluoride Residual as detected by Fluoride analyzer AE/AIT023 per the following equation:
      (Fluoride Analyzer Trim) = ((Target Fluoride Residual) – (Natural Fluoride Residual)) / ((Current Fluoride Residual) – (Natural Fluoride Residual))
      Where 120% ≥ (Fluoride Analyzer Trim) ≤ 80%
   f. PLC shall obtain the value for “Current Fluoride Residual” 60 seconds prior to performing the calculation, and the value for “Current Fluoride Residual” shall be updated in the calculation once every 30 seconds. If oldest/first obtainable value for “Current Fluoride Residual” is less than 60 seconds old, the oldest/first obtainable value shall be used until value history greater than or equal to 60 seconds.
   g. Plant PLC shall adjust the stroke frequency output to the Fluoride metering pump P849 based on the following equation:
      (Fluoride Pump Stroke Frequency) = (Total Filter Effluent Flow) * ((Target Fluoride Residual) – (Natural Fluoride Residual)) * (Fluoride Pump Stroke Frequency at Calibration) * (Fluoride Analyzer Trim) / ((Fluoride Pump Capacity at Calibration) * 314.5)
   h. SCADA OIT and Local HMI shall display the Calculated Fluoride Pump Flow of Fluoride pump P849 based on the following equation:
      (Calculated Fluoride Pump Flow) = (Fluoride Pump Stroke Frequency) * (Fl Pump Capacity at Calibration) / (Fluoride Pump Stroke Frequency at Calibration)
3. Start/Stop
   a. If any Raw Water Booster Pump is running and Total Filter Effluent Flow > 100 gpm (adjustable), call Fluoride pump to Start and. If flowmeter falls at or below 100 gpm (adjustable), stop Fluoride pump.
   b. Total Filter flow is the sum of Filter No. 1 influent flowmeter FE032 if Filter No. 1 Effluent valve V317 is open, plus Filter No. 2 Influent flowmeter FE042 if Filter No. 2 Effluent valve V417 is open. If a filter Effluent valve is not open, the corresponding filter’s flowmeter is assigned a value of zero for calculation purposes.

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) None
   2. Local Control Panel:
      a. Control Devices:
         1) None
      b. Indicators and Alarms:
         1) None

E. MCC Controls and Instrumentation:
   1. MCC Panels:
      a. MCC Control Devices.
         1) None
      b. Indicators and Alarms:
         1) RUN indication.
         2) RUN status for Fluoride Pump.
         3) FAIL indication.
         4) FAIL ALARM for Fluoride Pump.
      c. Hardwired Interlocks:
         1) None.

F. PLC/OIS Functions:
   1. Control:
      a. General
         1) RUN status of the Fluoride Pump is transmitted from the MCC to SCADA for indication.
         2) SCADA shall accumulate Fluoride Pump run time for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, previous 14 days, month to date, and previous calendar month.
         3) AUTO/MANUAL switch shall be provided in SCADA for Fluoride Pump.
         4) A START/STOP switch shall be available for manual control of the pump from SCADA.
      b. SCADA Manual Control Mode
         1) The Operator may place the Fluoride pump in MANUAL and start and stop the pump from SCADA, which will operate the Fluoride Pump until the Operator changes the operation.
      c. SCADA Automatic Control Mode
         1) When Fluoride Pump is IN SERVICE starting and stopping of the Fluoride shall be based on Raw Water Booster pump operation.
         2) Fluoride shall stop on the following conditions:
            a) HIGH Residual Fluoride ALARM
            b) Fluoride High Containment Level
            c) Both Filter Effluent Valves are closed
         3) If any Booster Pump is running and Treated Water flowmeter is greater than a START setpoint (adjustable) after an adjustable time delay, then call Chlorine Booster Pump 2 to operate. Pumps shall modulate as described above.

4) If the any Booster Pump is running and the Treated Water flowmeter is less than an adjustable STOP setpoint after an adjustable time delay, then remove the pump call to stop the Chlorine Booster Pump 2 and close Gas Regulator Control Valve 2.

2. Screen Indicators and Alarms at PLC/OIS:
   a. System
      1) Current Fluoride Residual = X.XX mg/L
      2) Target Fluoride Residual = X.XX mg/L
      3) Natural Fluoride Residual = X.XX mg/L
      4) Fluoride Analyzer Trim = XXX% (calculated)
      5) Fluoride Pump Stroke Frequency XX.X%
      6) Calculated Fluoride Pump Flow X.XX mg/L
      7) Total Filter Effluent Flow = X,XXX gpm (calculated)
      8) Fluoride Pump Fail
      9) Fluoride Pump OUT OF SERVICE status.
      10) Fluoride Pump Fail FAIL TO RESPOND ALARM indication.
      11) Post Filter Residual Fluoride indication
      12) HIGH Post Filter Residual Fluoride ALARM
      13) LOW Post Filter Residual Fluoride ALARM
      14)
   b. Software Interlock:
      1) None.
   c. Alarms Generated by SCADA:
      1) None

G. Special Considerations:
   1. Power outage and restore operation.
      a. During power outages, the pump with associated valves will not operate due to loss of power. The alarms will be de-activated at SCADA during power outages. Upon restoration of the power, pump and associated equipment shall resume normal operation. Alarms will be re-activated at SCADA upon restoration of power.

3.10 OUTSIDE LIGHT CONTROLS

A. References:
   1. Process Area: Area-Well, Filter, and TWPBS Area; Bollard-South perimeter and top of Tank.
   2. P&ID Drawing: P12.
   3. Mechanical Drawings: None.
   4. Specification Sections: 16500

B. Mechanical Equipment:

Tag Number	Equipment Name
None	

C. General Description:
   1. The Outside lights are controlled by the PLC to operate based on motion detected and active photocell.
   2. There are separate PLC controls for the Area lights and the Bollard lights.

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) Photocell PE059.
         2) Motion Sensors MS079A~D.
   2. Pumps:
      a. None.

E. MCC Controls and Instrumentation:
   1. MCC Panels:
      a. MCC Control Devices.
         1) HAND/ OFF/ AUTO selector switch – Area Lights
         2) HAND/ OFF/ AUTO selector switch – Bollard Lights

F. PLC/OIS Functions:
   1. Controls:
      a. SCADA Manual Control Mode:
         1) When the HAND/OFF/AUTO selector switch at the MCC is in the AUTO position and IN SERVICE, the Operator may turn on the Area Lights from SCADA, which will turn on Area Lights until the Operator changes the operation.
         2) When the HAND/OFF/AUTO selector switch at the MCC is in the AUTO position and IN SERVICE, the Operator may turn on the Bollard Lights from SCADA, which will turn on Area Lights until the Operator changes the operation.
      b. SCADA Automatic Control Mode:
         1) AREA Light - When there is a PHOTOCELL active and any MOTION detected (A~D), turn on Area Lights for an adjustable period of time. Additional motion will restart the timer.
         2) BOLLARD Light – the Bollard lights are always on.
   2. Screen Indicators and Alarms at PLC/OIS:
      a. System:
         a) PHOTOCELL Active Indication.
         b) MOTION Detected A Active Indication – TWBPS Area
         c) MOTION Detected B Active Indication – TWBPS Area
         d) MOTION Detected C Active Indication – Well & Filter Area
         e) MOTION Detected D Active Indication – Well & Filter Area
      b. Software Interlocks:
         1) None.
      c. Alarms Generated by SCADA:
         1) None.

G. Special Considerations:
   1. Power Outages and Restore Operation:
      a. During power outages the lights will not operate due to loss of power. Upon restoration of power the lights will operate as called as described above.

3.11 ALTITUDE VALVE (50ST)

A. References:
   1. Process Area: Water Storage Tank
   2. P&ID Drawing: P10.
   3. Mechanical Drawings: M701.
   4. Specification Sections: 15220.

B. Mechanical Equipment:

Tag Number	Equipment Name
50ST-ACV601	Altitude Control Valve

C. General Description:
   1. The 4MG Water Storage Tank will either be filled from SYSTEM PRESSURE or from WELL 165 PUMP. A SCADA/OIS STORAGE TANK FILL Selector switch shall be provided to select between the two methods to fill the Tank.
   2. Filling the Water Storage Tank on SYSTEM PRESSURE will utilize the Altitude Control Valve.

D. Local Controls and Instrumentation:
   1. System:
      a. Instruments and Protective Devices:
         1) Water Storage Tank.
            a) Ultrasonic type level transducer (50ST-LIT050).
            b) High High Level Switch (50ST-LSHH066)
         2) Altitude Valve.
            a) Close Control Solenoid (50ST-SV601C).
            b) Open Control Solenoid (50ST-SV601O).
            c) Position Transmitter (50ST-ZT601)
   2. Local Control Panel:
      a. Control Devices:
         1) None
      b. Indicators and Alarms:
         1) None

E. MCC Controls and Instrumentation:
   1. MCC Panels:
      a. MCC Control Devices.
         1) None
      b. Indicators and Alarms:
         1) POSITION indication.
      c. Hardwired Interlocks:
         1) None.

F. PLC/OIS Functions:
   1. Control:
      a. General
         1) Position indication of the Altitude valve is transmitted from the MCC to SCADA for indication.
         2) AUTO/MANUAL switch shall be provided in SCADA for the Altitude Valve.

3) A POSITION adjustment shall be available for manual control of the valve from SCADA.

b. SCADA Manual Control Mode

1) The Operator may place the Altitude Valve in MANUAL open and close it from SCADA, until the Operator changes the operation.

c. SCADA Automatic Control Mode

1) When STORAGE TANK FILL SCADA/OIS switch is in SYSTEM PRESSURE, operation of the Altitude Valve shall be based on the level in the Water Storage Tank.

2) If the Water Storage Tank is less than a START setpoint (adjustable) after an adjustable time delay, then call the Altitude Valve to open.

3) If the Water Storage Tank is greater than an adjustable STOP setpoint after an adjustable time delay, then generate an alarm to Warn the Operator that the Altitude Valve will shutdown on High High level.

2. Screen Indicators and Alarms at PLC/OIS:

a. System

1) Altitude Valve:

a) STORAGE TANK FILL mode indication

b) Altitude Valve position Indication.

c) Station Flow indication.

d) Altitude Valve OUT OF SERVICE status.

e) Altitude Valve FAIL TO RESPOND ALARM indication.

2) Water Levels:

a) WATER STORAGE TANK level indication.

b) HIGH HIGH Water Storage Tank ALARM.

c) Level Instrument Fail ALARM

b. Software Interlock:

1) The valve shall close on the following conditions:

a) Water Storage Tank

(1) HIGH HIGH Water Storage Tank level ALARM.

(2) Signal fail from station Flowmeter

b) Chemical System

(1) Fluoride High Containment ALARM.

(2) Fluoride Unit FAIL ALARM.

c. Alarms Generated by SCADA:

1) None.

G. Special Considerations:

1. Power outage and restore operation.

a. During power outages, the altitude valve will not operate due to loss of power. The altitude valve alarms will be de-activated at SCADA during power outages. Upon restoration of the power, altitude valve shall resume normal operation to fill Water Storage Tank. Alarms will be re-activated at SCADA upon restoration of power.

3.12 TREATED WATER PUMP STATION (60FW)

A. References:

1. Process Area: Treated Water Booster Pump Station.

2. P&ID Drawings: P12.

3. Mechanical Drawings: M801.
4. Specification Sections: 11303.

B. Mechanical Equipment:

Tag Number	Equipment Name
60FW-P611	Treated Water Booster Pump No. 1
60FW-P612	Treated Water Booster Pump No. 2
60FW-P613	Treated Water Booster Pump No. 3
60FW-P614	Treated Water Booster Pump No. 4

C. General Description:
1. The Treated Water Booster Pump Station will only run when the “4MG Water Storage Tank Fill” selection is in the WELL PUMP mode.
2. There are 2 constant speed and 2 VFD equipped variable speed pumps which pump finished water from the 4MG Water Storage Tank TW to the existing distribution system. The pumps are controlled automatically to maintain an operator selected Discharge pressure from the TWBPS to the distribution system. Monitoring of the TWBPS will be as shown on the P&ID’s.
3. For the four pumps, following the initial selection, whenever a pump shuts down, the pump assignment shall be rotated in order as selected by the Operator.

D. Local Controls and Instrumentation:
1. System:
   a. Instruments and Protective Devices:
      1) High Discharge Pressure Switch (each pump).
      2) Cable Intrusion (each pump).
      3) Discharge Pressure (60FW-PIT061)
      4) Station Flow (60FW-FIT092)
2. Local Control Panel:
   a. Control Devices:
      1) None.
   b. Interlocks:
      1) The individual pumps will shut down and send an alarm on HIGH PRESSURE detected at each of the pump discharge lines. Other pump shutdown alarms are HIGH TEMPERATURE.
   c. Logic:
      1) Local Manual Control Mode:
         a) None.
      2) Local Automatic Control Mode:
         a) None.

E. MCC Controls and Instrumentation:
1. MCC Panels:
   a. MCC Control Devices. (each pump)
      1) LOCAL/OFF/REMOTE selector switch.
      2) Control Power (CP) ON/OFF selector switch.
      3) SSS (Solid State Starter) or VFD RESET pushbutton.
      4) HI PRESSURE RESET pushbutton.
   b. Indicators and Alarms:
      1) READY indication.

2) READY status for well pump. Well Pump is READY under the following conditions:
   a) The equipment is in REMOTE.
   b) The CPT is active.
   c) The hardwired High Discharge Pressure Switch is not active.
   d) The Water Storage Tank Low Low level switch is not active
   e) There is not an active soft starter or VFD FAIL alarm.
3) RUN indication.
4) RUN status for well pump.
5) FAIL indication.
6) FAIL ALARM for well pump.

c. Hardwired Interlocks:
   1) A High Pressure switch is hardwired to shutdown the pump to prevent operation if the discharge pressure is above the High pressure switch setpoint. The High Pressure switch also provides an alarm to the PLC. This alarm requires a MANUAL reset with a pushbutton at the MCC.
   2) A Low-Low Level switch is hardwired to shutdown the pump to prevent operation if the Water Storage Tank level is below the Low-Low Level setpoint. The Low-Low Level switch also provides an alarm to the PLC.

F. PLC OIS Functions:
   1. Controls:
      a. General
         1) RUN and READY status of each Pump are transmitted from the MCC to SCADA for indication.
         2) SCADA shall accumulate each Pump's run time for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, previous 14 days, month to date, and previous calendar month.
         3) AUTO/MANUAL switches shall be provided in SCADA for each Pump.
         4) START/STOP switches shall be available for manual control of the pumps from SCADA.
      b. SCADA Manual Control Mode: (typical for all pumps)
         1) If the pump is not in REMOTE, then SCADA shall indicate it is NOT IN REMOTE.
         2) When LOCAL/ OFF/ REMOTE selector switch for Pump is in REMOTE position and IN SERVICE, the Operator may place the pump in MANUAL and start and stop the pump from SCADA, which will operate the well pump until the Operator changes the operation. The Operator may also adjust the speed of the VFD for that pump.
      c. SCADA Automatic Control Mode:
         1) When LOCAL/ OFF/ REMOTE for TW Booster Pumps are in REMOTE and IN SERVICE and the STORAGE TANK FILL SCADA/OIS switch is in SYSTEM PRESSURE, starting and stopping of the pumps shall be based on the System Pressure.
            a) There will also be a SCADA/OIS Selector switch TIME OF DAY Mode option for TW BOOSTER PUMP. If this mode is ENABLED, the TW Booster Pumps will be prevented from

operating between a START TIME (adjustable) and STOP TIME (adjustable) TIME OF DAY. If the mode is DISABLED, the TW Booster pumps will be called when necessary. These setpoints are different from the Well Pump TIME OF DAY setpoints.

2) If the System Pressure is less than a START setpoint (adjustable) after an adjustable time delay, then call the TW Booster Pumps to operate as follows:
   a) Run one VFD pump.
   b) Increase speed of the operating VFD pump.
   c) Reduce speed of the operating VFD pump and run a constant speed pump.
   d) Increase the speed of the operating VFD pump.
   e) Reduce speed of the operating VFD pump, and run a second constant pump.
   f) Increase the speed of the operating VFD pump. Only ONE VFD pump shall run at any given time.
   g) Output of the TWBPS will be decreased in opposite of the above order, and where called for an increase in VFD speed, instead the speed shall be reduced.
   h) The TWBPS will be stage off based on the level from reservoir and the altitude valve open position. If the reservoir is low or the altitude valve is open then shutdown the TW Booster pumps. The TWBPS shutdown at the LOW LOW Level will include shutting down the pumps in a controlled manner and inhibiting them from starting until the reservoir levels are no longer LOW, and the altitude valve is closed.

3) If the System Pressure is greater than an adjustable STOP setpoint after an adjustable time delay, then remove the pump calls to stop the Treated Water Booster Pumps.

2. Screen Indicators and Alarms at PLC/OIS:
   a. System:
      1) TW Booster Pump: (typical for all pumps)
         a) STORAGE TANK FILL mode indication
         b) Discharge Pressure Indication. (60FW-PIT061)
         c) SPEED indication.
         d) RUN indication.
         e) Run time meter: SCADA shall accumulate total pump run time and starts for each pump for the current day (reset at midnight), previous calendar day (midnight to midnight), previous 7 days, current week, month to date, previous calendar month and total runtime
         f) READY status: The status shall be transmitted to SCADA when a common alarm is not activated, the local selector switch is in REMOTE position, the pump is ready to run and the following alarm conditions are not active:
            (1) The hardwired High Discharge Pressure Switch is not active.
            (2) The Water Storage Tank Low-Low level switch is not active
            (3) There is not an active Soft Starter/VFD FAIL alarm.

g) COMMON FAIL ALARM: An alarm shall be transmitted to SCADA for motor overload, pump fail, high discharge pressure, and excessive starts per hour.
h) TW Booster Pump OUT OF SERVICE status.
i) TW Booster Pump FAIL TO RESPOND ALARM indication.
j) HIGH TW Booster Pump 1~4 discharge pressure (switch) ALARMs.
k) HIGH discharge pressure ALARM
l) LOW discharge pressure ALARM (only if associated pump is running)

2) Water Levels:
a) WATER STORAGE TANK level indication.
b) HIGH Water Storage Tank level ALARM
c) LOW Water Storage Tank level ALARM
d) LOW LOW Water Storage Tank ALARM.
e) HIGH HIGH Water Storage Tank ALARM.
f) Level Instrument Fail ALARM (for each instrument)

b. Software Interlock:
1) The pumps shall also stop on the following conditions:
a) TW Booster Pump (typical for each pump
(1) TW Booster Pump FAIL.
(2) TW Booster Pump FAIL TO RESPOND.
(3) HIGH TW Booster Pump (pressure switch) discharge pressure ALARM.
b) Water Storage Tank
(1) LOW LOW Water Storage Tank level ALARM.
c) Chemical System
(1) LOW CL2 residual post filter ALARM.
(2) HIGH HIGH CL2 residual post filter ALARM.
(3) LOW CL2 residual Treated Water Pump Station ALARM.
(4) HIGH HIGH CL2 residual Treated Water Pump Station ALARM.
(5) LOW fluoride residual ALARM.
(6) Fluoride Unit FAIL ALARM.
(7) CL2 Cylinders de-energized
(8) HIGH HIGH CL2 Chlorine gas leak ALARM.
(9) Signal Fail for System flowmeter.
d) Rotation of Pumps:
(1) When set to SEQUENCE_ROTATION, each time a VFD pump is shutoff, the VFD pumps shall alternate.
(2) Each time a constant speed pump is shutoff, it shall alternate.
(3) When set to RUN_TIME_ROTATION, each time a VFD pump is shutoff, it becomes ranked at the bottom of the queue of standby VFD pumps ready for operation based on the total runtime of the pump, e.g., the more runtime the pump has, the lower the rank it will be assigned. Each subsequent VFD pump which is shutoff will be placed in the same standby VFD pump queue, and all pumps within the queue will be re-ranked based on the total runtime of each pump from the order of least runtime at the top of the queue,

to the most runtime at the bottom of the queue. The next VFD pump to start when called for by the PLC will be the pump ranked at the top position in the queue.

(4) Each time a constant speed pump is shutoff, it becomes ranked at the bottom of the queue of standby constant speed pumps ready for operation based on the total runtime of the pump, e.g., the more runtime the pump has, the lower the rank it will be assigned. Each subsequent constant speed pump which is shutoff will be placed in the same standby constant speed pump queue, and all pumps within the queue will be re-ranked based on the total runtime of each pump from the order of least runtime at the top of the queue, to the most runtime at the bottom of the queue. The next constant speed pump to start when called for by the PLC will be the pump ranked at the top position in the queue.

(5) When set to FIXED_ROTATION, the pump rotation feature is disabled, and pumps will be called either 1-2, 2-1 or 3-4, 4-3.

c. Alarms Generated By SCADA:

1) SCADA shall alarm on Excessive Starts per Hour. Initially Excessive Starts per Hour shall be set at 6 starts per hour (0-12 starts per hour).

G. Special Considerations:

1. Power Outage and Restore Operation:

a. Power Outage and Restore Operation: During Power Outage the TWBPS Monitoring Equipment will de-energize and stop communicating due to loss of power. During Power Outage the alarms associated with the TWBPS Monitoring Equipment will remain activated at SCADA. Upon Power Restore the TWBPS Monitoring Equipment will restart monitoring and communicating to SCADA.

3.13 SURGE VESSELS AND AIR COMPRESSORS (NOT APPLICABLE)

3.14 MEDIUM VOLTAGE (4160 V) SWITCHGEAR MONITORING EQUIPMENT (NOT APPLICABLE)

3.15 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

3.16 21KV/4.16KV MAIN DISTRIBUTION SWITCHGEAR MONITORING EQUIPMENT (NOT APPLICABLE)

A. Special Considerations.

3.30 INTRUSION ALARMING AND GATE CONTROL

A. Provide alarming of all doors and gates including common alarms provided by the Hirsh equipment and power supplies.

B. Include programming for gate open relay at the PLC to open each gate with a SCADA controlled pushbutton.

3.31 POWER QUALITY MONITORS

A. Provide SCADA monitoring of all Power Quality Monitors. Power Monitoring Equipment shall communicate data to SCADA via Modbus TCP/IP protocol over copper Ethernet network. All values from the PQM's will be processed in closest PLC and SCADA will read the values in a consecutive register tabulated order. The PLC will zero registers if communications are lost after a time delay and provide a communications fail alarm. The programmer will provide math equations necessary for a correct floating point value provided to SCADA.

3.32 MANUAL RESET ALARMS

A. The following alarms require manual reset at the MCC:
   1. Well 165 Pump High Pressure.
   2. Well 165 Pump Fail.
   3. Methane Treatment System Aeration Blower Fail.
   4. Raw Water Booster Pump 1 Fail.
   5. Raw Water Booster Pump 2 Fail.
   6. Tank Drainage Pump Fail
   7. TW Booster Pump 1 Fail
   8. TW Booster Pump 1 High Pressure
   9. TW Booster Pump 2 Fail
   10. TW Booster Pump 2 High Pressure
   11. TW Booster Pump 3 Fail
   12. TW Booster Pump 3 High Pressure
   13. TW Booster Pump 4 Fail
   14. TW Booster Pump 4 High Pressure

B. The following alarms require manual reset at the HMI:
   1. Post Filter CL2 Residual Alarm.
   2. Post Filter High High CL2 Residual Alarm.
   3. Treated Water Pump Station Low CL2 Residual Alarm.
   4. Treated Water Pump Station High High CL2 Residual Alarm.
   5. Post Filter Low Fluoride Residual Alarm.
   6. Post Filter Fluoride Unit Fail Alarm.

END OF SECTION

SECTION 17201

LEVEL MEASUREMENT - SWITCHES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Ball float level switch.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Ball float level switch:

a. Siemens Water Technologies Corp 9G-EF.

b. ITT Flygt Model ENM-10.

c. Anchor Scientific Incorporated Ecofloat/Solofloat.

2. Flood level switch:

a. Gems LS-750.

b. Madison Company.

c. Approved Equal.

2.02 MANUFACTURED UNITS

A. Ball float level switch:

1. General:

a. Free hanging, encapsulated body with a switch to determine position of float.

2. Element:

a. Mechanical switch encapsulated in waterproof floating polypropylene ball of nominal diameter, supported by flexible PVC cable and jacket or heavy neoprene.

b. The length of the PVC cable shall be, at a minimum, equal to sump depth plus 5 feet.

c. Float: Provide type 316 SS, minimum 3 inches in diameter. The float shall provide a minimum of 2 pounds of buoyancy in solutions with specific gravity of 1 and shall have an operating temperature rating of -30 degrees Fahrenheit to +150 degrees Fahrenheit.

d. Mercury switches are not acceptable.

e. Lead wires: Mounted in flexible waterproof PVC cable from switch to junction box terminals without splices.

3. Switch:

a. Single pole double throw contacts rated 10 amps resistive at 120 VAC.

b. Provide the number of floats per level system as indicated on the Drawings.

c. Suspend ball float and adjust for level setpoint as required.

4. Components:

a. Floats shall include Type 316 stainless steel clamp and brackets and 1/4 inch cable to allow testing of the float without entering the basin or wet well.

b. Provide strain relief at both ends of the float cable.

c. Float anchors:

1) Furnish 15-pound PVC coated anchor kit with 10 feet of 316 stainless steel chain.

2) Provide stainless steel shackles and float clamps.

3) Manufactured by:

a) Conery Mfg. Inc.

b) Approved equal.

B. Flood Switch:

1. The level switch shall utilize a Buna-N level with slosh shield which moves with liquid level to actuate a SPST (single pole, single throw) NC switch. The switch contact shall open with rising level.

2. The level switch shall have a minimum electrical switch rating of 20 VA. The level switch shall have an operating temperature range of -40° to +180°F.

3. The level switch shall be suspended by PVC cable of sufficient length to reach bottom of the drywell and have a weighted collar.

4. Manufactured by:

a. Gems LS-750.

b. Madison Company

c. Approved equal.

2.03 ACCESSORIES

A. Provide sun shield for outdoor installations that use tuning fork or capacitance probe level switches.

B. All necessary test equipment shall be provided.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be as indicated on the Drawings, as specified in the Specifications or both.

END OF SECTION

SECTION 17202

LEVEL MEASUREMENT – SUBMERSIBLE LEVEL TRANSDUCER

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Submersible Hydrostatic Level Transducer.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Submersible Level Transducer shall be:

1. KPSI (By Measurement Specialties) Series 330 or equal.

2.02 MANUFACTURED UNITS

A. Submersible hydrostatic level transducer

1. General:

a. A submersible hydrostatic level transducer specifically designed for small bore applications and to meet the rigorous environments encountered in ground water level measurements.

2. Element:

a. Level Ranges: 5 thru 700FT H2O Vented Gage Reference

b. Wetted Materials: 316 SS or Titanium

c. Small bore, 0.75 inch diameter

d. Waterproof Enclosure: IP68 and NEMA 4X

e. Ported Nose Cap

3. Cable:

a. Cable Jacket Material – polyurethane

b. Cable pull strength – 200 lbs.

c. Number of conductors – 2 (22AWG) with a drain wire

d. Cable Seal – Molded Polyurethane.

e. Cable Length – sufficient length to reach from probe location to PLC cabinet without any splices, coil excess cable in cabinet.

4. Electrical:

a. 24 VDC Loop – powered; 4-20 ma output over the full level range

b. +/- 0.10% Accuracy

c. Operating temperature range -20 to 60 ˚C

2.03 ACCESSORIES

A. Provide cable hanger for installation and removal.

B. Provide vent filter model 811 for moisture prevention.

C. Provide lighting protection kit

D. Provide additional transducer with appropriate cable length as a spare.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be as indicated on the Drawings, as specified in the Specifications or both.

END OF SECTION

SECTION 17206

LEVEL MEASUREMENT - ULTRASONIC

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Ultrasonic level instruments.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: To match Owner Standard:

1. Ultrasonic Level sensor with 2-wire integral transmitter:

a. Endress+Hauser: Prosonic M FMU 40/41/42/43/44.

2.02 MANUFACTURED UNITS

A. Ultrasonic Level measurement with 2-wire integral transmitter:

1. General:

a. Continuous non-contact level measurement device with integral transmitter using ultrasonic echo sensing.

b. The transducer generates an ultrasonic pulse in the range of 12 to 60 kHz and measures the time required for the pulse to travel to the process surface and return. The level is measured based on constant velocity of sound in air with temperature compensation to adjust for velocity changes relative to temperature.

c. Each 2- or 3-wire level transmitter system includes, but is not limited to:

1) Ultrasonic transducer with integral transmitter.

2. Performance requirements:

a. Accuracy:

1) 0.25 percent of range.

b. Repeatability:

1) 0.1 percent of range.

3. Transducer (Integral):

a. Encapsulated in chemical and corrosion-resistant material as indicated on the Instrument Data Sheet or Instrument index.

b. Operating temperature range: -5 to 122 degrees Fahrenheit (-20 to 50 degrees Celsius).

c. Operating relative humidity range: 5 to 95 percent.

4. Transmitter:

a. Functions:

1) Single Level measurement.

2) Programmable for:

a) Level.

b) Tank volume.

b. Power supply:

1) 24 VDC - 2-wire loop powered.

2) Power consumption: 6 VA maximum.

c. Outputs:

1) Isolated 4-20 mA DC with HART communication protocol.

2) DTM certified by FDT group.

a) Instrument shall be listed in the FDT group's certified DTMs catalog.

d. Indicator: Liquid Crystal Display with approximately 0.50-inch display scaled to read in engineering units.

e. Sensitivity: Able to ignore momentary level spikes or momentary loss of echo and indicate loss of echo condition on indicating transmitter unit.

f. Enclosure:

1) NEMA Type 4X.

g. Mounting: As indicated in the Contract documents.

2.03 ACCESSORIES

A. Mounting brackets: As indicated on the Drawings.

B. Provide sun shield for outdoor installations.

C. Provide handheld programmers for all transmitters.

D. Provide all necessary test equipment.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

B. Factory calibrate each transmitter at a facility that is traceable to the National Institute of Standards and Technology (NIST).

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 2 hours of OWNER training.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be as indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

SECTION 17207

LEVEL MEASUREMENT - RADAR

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Radar level instruments.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: one of the following or equal

1. Radar Level sensor with 2-wire integral transmitter

a. Endress+Hauser: Micropilot FMR 51, to match Owner Standard.

2.02 MANUFACTURED UNITS

A. Radar Level measurement with 2-wire integral transmitter:

1. General:

a. Continuous non-contact level measurement device with integral antenna horn and transmitter.

b. Radar impulses are emitted by an antenna, reflected off the product surface and received again by the radar system. The measurement is not affected by changing media, temperature changes, gas blankets or vapors.

2. Performance requirements:

a. Accuracy:

1) +/- 0.025 percent of range.

2) K-band: 26GHz

3) Ambient Temperature -40 – 80 °C

b. Reaction Time:

1) Less than 0.8 seconds.

3. Transmitter:

a. Functions:

1) Single Level measurement.

2) Programmable for:

a) Level.

b) Tank volume.

b. Outputs:

1) Isolated 4-20 mA DC with HART communication protocol.

2) DTM certified by FDT group.

a) Instrument shall be listed in the FDT group's certified DTMs catalog.

c. Indicator: Liquid Crystal Display with approximately 0.50-inch display scaled to read in engineering units.

d. Sensitivity: Able to ignore momentary level spikes or momentary loss of echo and indicate loss of echo condition on indicating transmitter unit.

e. Enclosure: NEMA Type 4X.

f. Mounting: As indicated in the Contract documents

4. HistoROM data management concept for fast and easy commissioning, maintenance and diagnostics

5. Power supply:

a. 24VDC – 2-wire loop powered.

b. Power consumption: 6 VA maximum.

2.03 ACCESSORIES

A. Mounting brackets: As indicated on the Drawings.

B. Provide sun shield for outdoor installations.

C. Provide handheld programmers for all transmitters.

D. Provide all necessary test equipment.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

B. Factory calibrate each transmitter at a facility that is traceable to the National Institute of Standards and Technology (NIST).

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 2 hours of OWNER training.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be as indicated on the Drawings, specified in the Specifications or both.

END OF SECTION

SECTION 17301

FLOW MEASUREMENT - SWITCHES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Magnetic flow switches.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Drawings.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
2. Physical conditions:
   a. Installation and mounting requirements.
   b. Location within the process.
   c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal.
   1. Magnetic:
      a. Krohne Model DWM 1000.

2.02 MANUFACTURED UNITS

A. Magnetic type:
   1. General:
      a. The induced voltage of a conductive fluid across a magnetic field is converted into a switching signal.
   2. Performance requirements:
      a. Accuracy: ±5 percent.
   3. Switch characteristics:
      a. Housing material: Aluminum with epoxy finish or 316L stainless steel.
      b. Contact: Single pole single throw (SPST).
      c. Power supply: 120 VAC.
      d. Enclosure: NEMA Type 4X.

2.03 ACCESSORIES

A. Provide sun shield for thermal flow switches on all outdoor installations.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

B. Set/calibrate each flow switch at a facility that is traceable to the National Institute of Standards and Technology.

C. Record and certify actual set/calibration data indicating the dead band between the increasing stage and decreasing stage of activating points shall be by the technician and submit the document to the ENGINEER at least 30 days before shipment of the switches to the project site.

D. Provide complete documentation covering all set/calibration instruments.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 8 hours of OWNER training.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be indicated on the Drawings, specified in the Specifications or both.

END OF SECTION

SECTION 17302

FLOW MEASUREMENT – MAGNETIC FLOWMETERS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Full-body magnetic flowmeters.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Drawings.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Endress+Hauser: Proline Promag L400 with IP 68 rating, or equal.

2.02 MANUFACTURED UNITS

A. Magnetic flowmeter:

1. General:

a. Magnetic flowmeters obtain the flow velocity by measuring the changes of induced voltage of the conductive fluid passing across a controlled magnetic field.

b. Complete zero stability shall be an inherent characteristic of the flowmeter system.

c. Include for each magnetic flow metering system:

1) A metering tube with electrodes (sensor).

2) Signal cable.

3) Transmitter integral or remote as indicated on the Drawings.

4) Flowmeter grounding rings.

2. Performance requirements:

a. Accuracy:

1) 0.05 percent of full scale.

b. Repeatability:

1) +/- 0.1 percent of reading.

3. Element:

a. Metering tube:

1) Constructed of carbon steel (unless specifically noted otherwise in the instrument data sheets) with flanged connections to match with piping material.

2) Liner material in conformance with:

a) Manufacturer's recommendations for the intended service.

b) NSF certified for all drinking water applications.

3) Electrodes type and material in conformance with:

a) Manufacturer's recommendations for the intended service.

b) Utilize a minimum of 2, self-cleaning electrodes with bullet nose

4) Meter terminal housing NEMA Type 6P unless specifically noted otherwise in the instrument data sheets.

5) Meter coating consisting of epoxy painted finish.

6) Components:

a) 2 grounding rings:

(1) Which are in conformance with the manufacturer's bore and material recommendation for the meter's intended service.

(2) Designed to protect and shield from abrasion of the liner's edge interface at the meter's end.

4. Transmitter:

a. Power supply:

1) 120 VAC /24 VDC per contract drawing.

2) Power consumption: 60 VA maximum.

b. Outputs:

1) Ethernet/IP Communication Protocol.

c. Microprocessor-based signal converter/transmitter.

d. Utilize DC pulse technique to drive flux-producing coils.

e. Contain a 6-digit display for flow rate, percent of span, and totalizer.

f. Operator keypad interface.

g. Integral zero return to provide consistent zero output signals in response to an external dry contact closure.

h. Integral low flow cut-off zero return.

i. Programmable parameters including:

1) Meter size.

2) Full-scale flow rate.

3) Magnetic field frequency.

4) Time constant.

j. Data retention for a minimum of 5 years without auxiliary main or battery power.

k. Self-diagnostics and automatic data checking.

l. Protected terminals and fuses in a separate compartment which isolates field connection from electronics.

m. Ambient operating temperature limits of -5 to 140 degrees Fahrenheit (-29 to 60 degrees Celsius).

n. Calibration verification.

2.03 ACCESSORIES

A. Stainless steel tag labeled as specified in the Contract Documents.

B. Provide sunshades for all transmitters located outdoors.

C. Provide galvanic isolation gaskets, nylon/Teflon flange bolt insulation bushings and nylon washers on all meters installed on pipes with cathodic protection.

D. Furnish 1 spool piece for every size of magnetic flow tube being provided.

E. Electronic tester for calibration verification and diagnostics.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

B. Factory calibrate each flow metering system at a facility that is traceable to the National Institute of Standards and Technology (NIST).

C. A real-time computer-generated printout of the actual calibration data indicating apparent and actual flows at 20 percent, 40 percent, 60 percent, 80 percent and 100 percent of the calibrated range shall be submitted to the ENGINEER at least 30 days before shipment of the meters to the project site.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. Instrument Data Sheets included in this section.

B. The provided information does not necessarily include all required instruments.

C. Provide all instruments identified in the Contract Documents:

1. Instruments may be indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

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SECTION 17316

FLOW MEASUREMENT – ROTAMETERS (VARIABLE AREA FLOWMETERS)

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Rotameters (variable area flowmeters).

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. ABB.

2. Brooks.

3. King Instrument Company.

2.02 MANUFACTURED UNITS

A. Rotameters:

1. General:

a. Variable area type flowmeters with local flow indication.

b. Glass tube type. Metal tube type:

1) For applications above 100 psig, with hazardous fluids, or with opaque liquids, provide a metal meter tube.

2. Performance requirements:

a. Flow range:

1) As specified in instrument data sheets or instrument index.

b. Accuracy:

1) Glass tube: ±2.0 percent of range.

2) Metal tube: ±5.0 percent of range.

3) Repeatability: 0.50 percent of range.

3. Element:

a. Flow tube:

1) Glass tube: Borosilicate glass, or as required to be compatible with the process conditions.

b. Metal tube with magnetic follower: 316 stainless steel.

c. Turndown: 10 to 1.

d. Process temperature:

1) Glass tube: 32 to 200 degrees Fahrenheit.

2) Metal tube: -20 to 320 degrees Fahrenheit.

e. Maximum process pressure:

1) Glass tube: 100 psig.

2) Metal tube: 450 psig.

3) Size tube for the largest of the following:

a) 2.0 times the normal flow rate.

b) 1.2 times the maximum flow rate.

c) 4.0 times the minimum flow rate.

4) Polycarbonate operator protection shield.

f. Float:

1) Metal tube rotameters: Float with encapsulated magnet.

4. Components:

a. Seals: O-rings or packing glands fully compatible with process fluid.

b. Integral needle valve for flow control.

5. Scale:

a. Metal tube: Dial indicator with rotatable magnet coupled to magnet encapsulated in rotameter float.

6. Other:

a. Process connection:

1) As indicated on the Mechanical Drawings.

b. Mounting:

1) As indicated on the Drawings.

2) Provide all necessary hardware for rotameter mounting.

2.03 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

SECTION 17401

PRESSURE/VACUUM MEASUREMENT - DIAPHRAGM AND ANNULAR SEALS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Diaphragm seals.
2. Annular seals.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.
3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.
   a. Section 01330 - Submittal Procedures.
   b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all seals identified in the Contract Documents.

1.02 REFERENCES

A. Refer to Section 17050.

1.03 DEFINITIONS

A. Refer to Section 17050.

1.04 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 17050.

B. Additional Requirements:

1. Product Data:
   a. Manufacturer's installation instructions.
   b. Seal type.
   c. Body materials.
   d. Diaphragm material.
   e. Fill fluid type.
   f. Seal size.
   g. Options.
   h. Process connection.

1.05 QUALITY ASSURANCE

A. Refer to Section 17050.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
2. Physical conditions:
   a. Installation and mounting requirements.
   b. Location within the process.
   c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. Refer to Section 17050.

1.08 WARRANTY

A. Refer to Section 17050.

1.09 MAINTENANCE

A. Refer to Section 17050.

B. Provide spare annular seal for every size indicated in the project.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Diaphragm Seals:

1. For, liquids containing solids, and liquids with pulsating flow having pressures less than or equal to 15 psi: One of the following or equal:
   a. Ashcroft, Type 301.
   b. Mansfield and Green, Type LG.
   c. Wika.
   d. Rosemount.
2. For liquids containing solids, and liquids with pulsating flow having pressures greater than or equal to 15 psi: One of the following or equal:
   a. Ashcroft, Type 101.
   b. Mansfield and Green, Type RG.
   c. Wika.
   d. Rosemount.

3. For chemical applications: One of the following or equal:
    a. Ashcroft, Type 101.
    b. Mansfield and Green, Type RG.
    c. Wika.
    d. Rosemount.

B. Annular Seals:

1. One of the following or equal:
    a. Red Valve.
    b. Ashcroft Iso-Ring.
    c. Onyx Valve.

2.02 MANUFACTURED UNITS

A. Diaphragm Seals:

1. General:
    a. Diaphragm seal and pressure instrument shall be assembled by pressure instrument manufacturer and shipped as an assembly.
2. Requirements:
    a. Seal Type: Welded.
    b. Process Connection: 1 inch NPT.
    c. Instrument Connection: 1/2 inch NPT.
    d. Provide 1/4-inch flushing connection in diaphragm housing or provide flushing ring.
    e. Provide fill/bleed connection.
    f. Provide bonded diaphragm.
    g. Mounting: As indicated in the Contract Documents.
    h. Provide 316 stainless steel armored capillary for all remote installations.
    i. Nuts and Bolts: 316 stainless steel.
    j. Materials of Construction:
        1) Sewage, sludge, liquids containing solids, and liquids with pulsating flow having pressures less than or equal to 15 psi:
            a) Diaphragm: Viton.
            b) Lower Housing: 316 stainless steel.
            c) Upper Housing: Manufacturer’s standard.
            d) Fill Fluid: Silicon oil.
        2) Sewage, sludge, liquids containing solids, and liquids with pulsating flow having pressures greater than 15 psi:
            a) Diaphragm: 316 stainless steel.
            b) Lower Housing: 316 stainless steel.
            c) Upper Housing: Manufacturer’s standard.
            d) Fill Fluid: Silicon oil.
        3) Chlorine:
            a) Diaphragm: Tantalum.
            b) Lower Housing: Hastelloy C.
            c) Upper Housing: Manufacturer’s standard.
            d) Fill Fluid: Halocarbon.
        4) Ferric Chloride:
            a) Diaphragm: PTFE.
            b) Lower Housing: PVC.
            c) Upper Housing: Manufacturer’s standard.

d) Fill Fluid: Silicon oil.

5) Fluorosilicic Acid:
   a) Diaphragm: Viton.
   b) Lower Housing: PVC.
   c) Upper Housing: Manufacturer's standard.
   d) Fill Fluid: Silicon oil.
6) Hydrochloric Acid:
   a) Diaphragm: PVDF.
   b) Lower Housing: Hastelloy B2.
   c) Upper Housing: Manufacturer's Standard.
   d) Fill Fluid: Fluorolube.
7) Ozone:
   a) Diaphragm: 316 stainless steel.
   b) Lower Housing: 316 stainless steel.
   c) Upper Housing: Manufacturer's standard.
   d) Fill Fluid: Halocarbon.
8) Potassium Permanganate:
   a) Diaphragm: PTFE.
   b) Lower Housing: PVDF.
   c) Upper Housing: Manufacturer's standard.
   d) Fill Fluid: Halocarbon.
9) Sodium Permanganate:
   a) Diaphragm: PTFE.
   b) Lower Housing: PVDF.
   c) Upper Housing: Manufacturer's standard.
   d) Fill Fluid: Halocarbon.
10) Sodium Hydroxide:
   a) Diaphragm: Monel.
   b) Lower Housing: Monel.
   c) Upper Housing: Manufacturer's standard.
   d) Fill Fluid: Silicon oil.
11) Sulfur Dioxide:
   a) Diaphragm: PTFE.
   b) Lower Housing: PVDF.
   c) Upper Housing: Manufacturer's standard.
   d) Fill Fluid: Halocarbon.
12) Sulfuric Acid:
   a) Diaphragm: PTFE.
   b) Lower Housing: Hastelloy B2.
   c) Upper Housing: Manufacturer's Standard.
   d) Fill Fluid: Halocarbon.
13) Other Process Fluids: As recommended by manufacturer and with Engineer's approval.

B. Annular Seals:

1. General:
   a. Inside diameter of annular seal shall provide uninterrupted flow:
      1) There shall be no dead ends or crevices.
      2) Process flow shall be sufficient to make the annular seal self-cleaning.

b. The pressure sensing flexible cylinder shall measure pressure around the full inside circumference of the pipeline.

2. Requirements:
   a. Pressure Rating: Equivalent to the ANSI flanges.
   b. Materials of Construction:
      1) Inner Flexible Cylinder: Manufacturer's standard.
      2) Body: Carbon steel.
      3) Assembly Flanges: To match adjacent piping.
      4) Fill Fluid: Silicon oil.
   c. Nominal Pipe Size: As indicated on the Drawings.
   d. Process Connection: Wafer.
   e. Instrument Connection: 1/2 inch NPT.

2.03 ACCESSORIES

A. Provide field fill kits.

2.04 SOURCE QUALITY CONTROL

A. Refer to Section 17050.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

   1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. Refer to Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. Refer to Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

3.06 PROTECTION

A. Refer to Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications or both.

END OF SECTION

SECTION 17402

PRESSURE/VACUUM MEASUREMENT – INSTRUMENT VALVES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Valve manifolds and instrument valves.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all valve manifolds and instrument valves identified in the Contract Documents.

1.02 REFERENCES

A. Refer to Section 17050.

1.03 DEFINITIONS

A. Refer to Section 17050.

1.04 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 17050.

B. Additional Requirements:

1. Product Data:

a. Valve type.

b. Body material.

c. Size.

d. Options.

2. Shop Drawings:

a. Mounting details for all manifold valves.

1.05 QUALITY ASSURANCE

A. Refer to Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 17050.

B. Protect valve manifolds and protective coatings from damage during handling and installation. Repair coating where damaged.

1.07 PROJECT OR SITE CONDITIONS

A. Refer to Section 17050.

1.08 WARRANTY

A. Refer to Section 17050.

1.09 MAINTENANCE

A. Refer to Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Valve Manifold Manufacturers: One of the following or equal:

1. Anderson Greenwood.

2. Hex Valve.

3. Noshok.

4. Rosemount.

B. Block and Bleed Valve Manufacturers: One of the following or equal:

1. Anderson Greenwood.

2. Hex Valve.

C. Gauge Valve Manufacturers: One of the following or equal:

1. Anderson Greenwood.
2. Hex Valve.

D. Level Sensor Isolation Valve Manufacturers: One of the following or equal:

1. Indu-Tech Level Sensor Isolation Valve.
2. DeZURIK Level Sensor Isolation Valve.
3. Tyco Rovalve Isolation Knife Gate Valve.

2.02 MANUFACTURED UNITS

A. Valve Manifolds:

1. General:

a. Provide 2-Valve, 3-valve, blowdown type 5-valve, or metering type 5-valve manifolds as indicated on the Drawings.

b. Valve manifolds shall have one piece bonnet with a metal to metal seal to the valve body below the bonnet threads.

2. Requirements:

a. Bonnet lock pin to prevent accidental loosening.

b. Gas leak tested metal-to-metal hard seat design for hard seat valves.

c. Gas leak tested soft seat design with replaceable seat for soft seat valves.

d. Manifold valves shall have straight through portion for bi-directional flow and easy roddable cleaning.

e. Manifold valves shall allow for direct or remote instrument mounting.

f. Shall be able to withstand pressures up to 6,000 psi for soft seat valves and 10,000 psi for hard seat valves at maximum 200 degrees Fahrenheit.

g. Materials of Construction:

1) Body Material: 316 Stainless Steel.

2) O-Ring: Teflon.

h. 2-Valve Manifolds:

1) 1 isolation valve and 1 drain/vent and calibration valve.

i. 3-Valve Manifolds:

1) 2 isolation valves and 1 equalizing valve for differential pressure applications.

2) Plugged vent connections used for vent/drain or calibration.

j. Blowdown 5-Valve Manifold:

1) 2 isolation valves, 1 equalizing valve, 2 blowdown valves for differential pressure applications.

k. Metering 5-Valve Manifold:

1) 2 isolation valves, 2 equalizing valves, 1 vent/drain and calibration valve for differential pressure applications.

B. Block and Bleed Valves:

1. General:

a. Valve shall provide process isolation and venting/draining capabilities.

b. Gas leak tested metal-to-metal hard seat design for hard seat valves.

c. Gas leak tested soft seat design with replaceable seat for soft seat valves.

d. Gauge valve shall be provided for calibration of gauge in place.

2. Requirements:

a. Materials of Construction:

1) Body Material: 316 Stainless Steel.

2) O-Ring: Teflon.

C. Gauge Valves:

1. General:

a. Valve shall provide process isolation from pressure instrument.

b. Gas leak tested, metal-to-metal hard seat design for hard seat valves.

c. Gas leak tested soft seat design with replaceable seat for soft seat valves.

2. Requirements:

a. Materials of Construction:

1) Body Material: 316 Stainless Steel.

2) O-Ring: Teflon.

D. Level Sensor Isolation Valves:

1. General:

a. Valve shall provide process isolation from level diaphragm.

b. Gas leak tested, metal-to-metal hard seat design for hard seat valves.

c. Gas leak tested soft seat design with replaceable seat for soft seat valves.

2. Requirements:

a. Materials of Construction:

1) Body Material: 316 Stainless Steel.

2) Flange Diameter Size: 3 inches.

2.03 ACCESSORIES

A. Provide tube fitting, female NPT, or pipe butt weld connections if necessary.

B. Provide stainless steel concentric or eccentric pipe nipples when necessary.

2.04 SOURCE QUALITY CONTROL

A. Refer to Section 17050.

B. Factory calibrate each instrument at a facility that is traceable to the National Institute of Testing Standards (NIST).

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. Refer to Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. Refer to Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 8 hours of OWNER training.

3.06 PROTECTION

A. Refer to Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications or both.

END OF SECTION

SECTION 17403

PRESSURE/VACUUM MEASUREMENT - SWITCHES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Pressure/vacuum switches.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

c. Section 17401 - Pressure/Vacuum Measurement - Diaphragm and Annular Seals.

d. Section 17402 - Pressure/Vacuum Measurement - Instrument Valves.

C. Provide all instruments specified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.03 DEFINITIONS

A. As specified in Section 17050.

B. NEMA:

1. Type 4 enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

B. Additional requirements:

1. Product data:

a. Accessories such as diaphragm seals, valve manifold, snubbers, and pulsation dampeners.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Mechanical type pressure switch: One of the following or equal:

1. Ashcroft B Series Type 400.

2. United Electric Controls 400 Series.

3. ASCO S-Series.

2.02 MANUFACTURED UNITS

A. Mechanical type pressure switches:

1. General:

a. Pressure switch shall be diaphragm or diaphragm-sealed piston type.

2. Performance requirements:

a. Pressure range:

b. Accuracy:

1) ±1.0 percent of range.

c. Repeatability:

1) ±1.0 percent of range.

3. Element:

a. Type: Diaphragm, diaphragm-sealed piston, or bourdon tube.

b. Overpressure:

1) Minimum 130 percent of maximum range pressure without damage to switch or sensing element.

2) Minimum 400 percent of nominal range without leakage or rupture.

c. Sensing element shall not require ambient temperature compensation.

d. Wetted materials: Stainless steel 316.

e. Setpoint:

1) Dual.

2) Switch shall activate at setpoint on increasing pressure for high-pressure alarm applications and on decreasing pressure for low-pressure alarm applications.

f. Fixed deadband.

g. Switch elements:

1) Snap acting.

2) 2 single pole-double throw (SPDT).

3) Rated at 5 A, 125/250 VAC.

4) Automatic reset type.

h. Enclosure: Epoxy coated NEMA Type 4.

i. Switch mounting:

1) Process connection: 1/2-inch NPT.

4. Components:

a. Provide all necessary hardware for pressure switch mounting.

2.03 ACCESSORIES

A. Pulsation dampeners and snubbers:

1. Provide pulsation dampener or snubber with each pressure switch installed on discharge of positive displacement type pump.
2. Materials: Stainless steel 316.
3. Mount pulsation dampener or snubber integrally to the pressure switch.
4. Connection: 1/2-inch NPT.

B. Provide integral diaphragm seals as indicated on the Drawings and as specified in Section 17401:

1. Diaphragm seal and pressure switch shall be assembled by manufacturer and shipped as an assembly.

C. Furnish block and bleed valves as specified in Section 17402.

D. Furnish gauge valves as specified in Section 17402.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

B. Factory calibrate each instrument at a facility that is traceable to the National Institute of Standards and Technology (NIST).

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 1 hour of OWNER training.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments specified in the Contract Documents:

1. Instruments may be indicated on the Drawings, specified in the Specifications or both.

END OF SECTION

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SECTION 17404

PRESSURE/VACUUM MEASUREMENT - GAUGES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Pressure/vacuum gauges.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

c. Section 17401 - Pressure/Vacuum Measurement - Diaphragm and Annular Seals.

d. Section 17402 - Pressure/Vacuum Measurement - Instrument Valves.

C. Provide all instruments specified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

B. American Society of Mechanical Engineers (ASME):

1. B40.100 - Pressure Gauges and Gauge Attachments.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

B. Additional requirements:

1. Product data:

a. Accessories such as diaphragm seals, valve manifold, snubbers, and pulsation dampeners.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: One of the following or equal:

1. Ashcroft:

a. Maximum pressure less than 10 psi: Model 1009.

b. Maximum pressure greater than or equal to 10 psi: Model 1279

2. Wika.

3. Ametek U.S. Gauge.

2.02 MANUFACTURED UNITS

A. General:

1. Pressure gauge assembly shall include pressure sensing element, gauge case, and dial mechanism.

B. Performance requirements:

1. Pressure range:

a. As specified in the Contract Documents.

2. Accuracy:

a. Grade 2A, as defined by ASME B40.100.

b. ±1.0 percent of span after friction errors are eliminated by tapping or vibration.

c. Maximum allowable friction inaccuracy: ±1.0 percent of span.

3. Element:

a. Where the maximum pressure is less than 10 psi, provide socket and bellows; for all other pressure ranges, employ a Bourdon tube.

b. Socket tips for bellows and Bourdon tube:

1) Materials: Type 316 stainless steel.

c. Overpressure: Minimum 130 percent of maximum range pressure without damage to gauge or sensing element.

d. Wetted materials: 316 stainless steel.

4. Dial gauge:

a. Dial size: 4-1/2 inches.

b. Dial case material: Stainless steel

c. Provide safety gauge with rupture disk and blow out back.

d. Dial face: Gasketed shatterproof glass

e. Provide gauge locks where possible.

f. Connection and mounting:

1) Direct mounted and suitable for outdoor installation.

2) 1/2 inch NPT.

3) Connection material: Stainless steel.

g. Pointer: Externally adjustable.

h. Glycerin filled.

2.03 ACCESSORIES

A. Pulsation dampeners and snubbers:

1. Provide pulsation dampener or snubber with each pressure gauge installed on discharge of positive displacement type pump.

2. Provide piston-type snubber if pressure spikes will exceed 130 percent of gauge maximum range.

3. Materials: 316 stainless steel.

4. Mount pulsation dampener or snubber integrally to the pressure gauge.

5. Connection: 1/2-inch NPT.

B. Provide diaphragm seals as specified in the Contract Documents and in Section 17401:

1. Diaphragm seal and pressure gauge shall be assembled by manufacturer and shipped as an assembly.

C. Provide means for gauge isolation as specified in Section 17402:

1. Mount valve manifold integrally to the gauge.

2. Valve manifold and pressure gauge shall be assembled by manufacturer and shipped as an assembly.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

B. Factory calibrate each pressure gauge at a facility that is traceable to the National Institute of Standards and Technology (NIST).

C. Provide complete documentation covering the traceability of all calibration instruments.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning:

1. Furnish 0.5 hours of OWNER training.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be indicated on the Drawings, specified in the Specifications or both.

END OF SECTION

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SECTION 17405

PRESSURE/VACUUM MEASUREMENT - DIRECT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Pressure transmitters and indicators.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

c. Section 17401 - Pressure/Vacuum Measurement - Diaphragm and Annular Seals.

d. Section 17402 - Pressure/Vacuum Measurement - Instrument Valves.

C. Provide all instruments identified in the Contract Drawings.

1.02 REFERENCES

A. Refer to Section 17050.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.03 DEFINITIONS

A. Refer to Section 17050.

B. NEMA:

1. Type 4X enclosure in accordance with NEMA 250.

C. Specific Definitions:

1. Lower Range Value (LRV): Lowest pressure that the pressure transmitter is capable of measuring.

2. Upper Range Value (URV): Highest pressure that the pressure transmitter is capable of measuring.

3. Calibrated Range: The range that the pressure transmitter is configured to measure. The low end of the calibrated range must be greater than the LRV of the transmitter. The high end of the calibrated range must be less than or equal to the URV. The calibrated range corresponds to the flow signal sent from the transmitter.

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 and 17050.

B. Product Data:

1. Accessories such as diaphragm seals, valve manifold, snubbers, and pulsation dampeners.

1.05 QUALITY ASSURANCE

A. Refer to Section 17050.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. Refer to Section 17050.

1.08 WARRANTY

A. Refer to Section 17050.

1.09 MAINTENANCE

A. Refer to Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Rosemount: 3051 Series.
2. Yokogawa: EJA Series.
3. ABB: 264 Series.
4. Endress & Hauser: Cerabar S Series.
5. SMAR: LD300 Series.

2.02 MANUFACTURED UNITS

A. Pressure Transmitters - Direct:

1. General:

a. Pressure transmitter assembly shall include a diaphragm type pressure transducer and microprocessor based transmitter for measurement of gauge, vacuum, or absolute pressure.

2. Performance requirements:

a. Maximum ratio of total instrument range to calibrated span: 10 to 1.

b. Accuracy:

1) Reference Accuracy: Plus or minus 0.075 percent of calibrated span, including effects of hysteresis, nonlinearity, and repeatability.

2) Total Performance Accuracy: Plus or minus 0.30 percent of calibrated span, including reference accuracy effects, static pressure and ambient temperature effects.

3) Stability: Plus or minus 0.15 percent of upper range limit over 5 years.

3. Element:

a. Diaphragm type transducer integral to pressure transmitter.

b. Diaphragm material: Stainless steel or ceramic.

c. Process Material Compatibility:

1) Verify all material compatibilities with the instrument Manufacturer.

d. Process Connection: As indicated in the Instrument Data Sheets or Instrument Index.

4. Transmitter:

a. Power supply:

1) 24 VDC - 2 wire loop powered.

2) Power consumption: 3 VA maximum.

b. Outputs:

1) Isolated 4-20mA DC with HART communication protocol.

c. Provided with electronic microprocessor.

d. Adjustments: Adjustable electronic zero and span, with elevated or suppressed zero as required by application. Adjustment shall be possible without mechanical fulcrum points or handheld configurator.

e. Local Display:

1) 5-digit LCD.

2) Scaled in engineering units.

f. Enclosure: NEMA Type 4X.

g. Over range Protection: To maximum process line pressure.

h. Conduit: 1/2 inch male NPT.

5. Components:

a. Transmitter Mounting:

1) As indicated in the Instrument Data Sheets or Instrument Index.

2) Provide all necessary hardware for transmitter mounting.

2.03 ACCESSORIES

A. Provide valve manifolds as specified in Section 17402:

1. Mount valve manifold integrally to the transmitter.

2. Valve manifold and transmitter shall be assembled by Manufacturer and shipped as an assembly.

3. Provide remote or integral diaphragm seals as indicated in the Instrument Data Sheets or the Instrument Index, and as specified in Section 17401.

B. Provide sun shield for outdoor installations.

2.04 SOURCE QUALITY CONTROL

A. Refer to Section 17050.

B. Factory calibrate each pressure transmitter with a 5 point calibration at a facility that is traceable to the National Institute of Standards and Technology.

C. Provide complete documentation covering the traceability of all calibration instruments.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 17050

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration

3.04 CLEANING

A. Refer to Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. Refer to Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 8 hours of OWNER training.

3.06 PROTECTION

A. Refer to Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications, or both.

END OF SECTION

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SECTION 17406

PRESSURE/VACUUM MEASUREMENT - DIFFERENTIAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Differential pressure transmitters and indicators.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

c. Section 17401 - Pressure/Vacuum Measurement - Diaphragm and Annular Seals.

d. Section 17402 - Pressure/Vacuum Measurement - Instrument Valves.

C. Provide all instruments identified in the Contract Drawings.

1.02 REFERENCES

A. Refer to Section 17050.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.03 DEFINITIONS

A. Refer to Section 17050.

B. Specific Definitions:

1. Lower Range Value (LRV): Lowest pressure that the pressure transmitter is capable of measuring.

2. Upper Range Value (URV): Highest pressure that the pressure transmitter is capable of measuring.

3. Calibrated Range: The range that the pressure transmitter is configured to measure. The low end of the calibrated range must be greater than the LRV of the transmitter. The high end of the calibrated range must be less than or equal to the URV. The calibrated range corresponds to the flow signal sent from the transmitter.

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 and 17050.

B. Product Data:

1. Accessories such as diaphragm seals, valve manifold, snubbers, and pulsation dampeners.

1.05 QUALITY ASSURANCE

A. Refer to Section 17050.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. Refer to Section 17050.

1.08 WARRANTY

A. Refer to Section 17050.

1.09 MAINTENANCE

A. Refer to Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:

1. Rosemount: 3051 Series.
2. Yokogawa: EJA Series.
3. ABB: 264 Series.
4. Endress & Hauser: Cerabar S Series.
5. SMAR: LD300 Series.

2.02 MANUFACTURED UNITS

A. Pressure Transmitters - Differential:

1. General:
   a. Pressure transmitter assembly shall include a diaphragm type pressure transducer and microprocessor based transmitter for measurement of differential pressure.
   b. Differential pressure transmitters shall be used for differential pressure, flow, or liquid level measurement as indicated on the Drawings.
2. Performance requirements:
   a. As specified in data sheets or instrument index.
   b. Maximum ratio of total instrument range to calibrated span: 10 to 1.
   c. Accuracy:
      1) Reference Accuracy: Plus or minus 0.075 percent of calibrated span, including effects of hysteresis, nonlinearity, and repeatability.
      2) Total Performance Accuracy: Plus or minus 0.30 percent of calibrated span, including reference accuracy effects, static pressure and ambient temperature effects.
      3) Stability: Plus or minus 0.15 percent of upper range limit over 5 years.
3. Element:
   a. Diaphragm type transducer integral to pressure transmitter.
   b. Diaphragm material: Stainless steel or ceramic.
   c. Process Material Compatibility:
      1) Verify all material compatibilities with the instrument Manufacturer.
   d. Process Connection: 1/2inch NPT.

4. Transmitter:

a. Power supply:

1) 24 VDC - 2 wire loop powered.

2) Power consumption: 3 VA maximum.

b. Outputs:

1) Isolated 4-20mA DC with HART communication protocol.

c. Provided with electronic microprocessor.

d. Adjustments: Adjustable electronic zero and span, with elevated or suppressed zero as required by application. Adjustment shall be possible without mechanical fulcrum points or handheld configurator.

e. Local Display:

1) 5-digit LCD.

2) Scaled in engineering units.

f. Enclosure: NEMA Type 4X.

g. Over range Protection: To maximum process line pressure.

h. Conduit: 1/2 inch male NPT.

5. Components:

a. Transmitter Mounting:

1) As indicated in the Instrument Data Sheets or Instrument Index.

2) Provide all necessary hardware for transmitter mounting.

2.03 ACCESSORIES

A. Provide 3-valve manifolds as specified in Section 17402:

1. Mount valve manifold integrally to the transmitter.

2. Valve manifold and transmitter shall be assembled by Manufacturer and shipped as an assembly.

B. Provide integral diaphragm seals as indicated on the Drawings and as specified in Section 17401.

1. Diaphragm seal and transmitter shall be assembled by manufacturer and shipped as an assembly.

C. Provide sun shield for outdoor installations.

2.04 SOURCE QUALITY CONTROL

A. Refer to Section 17050.

B. Each differential pressure transmitter shall be factory calibrated with 5-point calibration at a facility that is traceable to the National Institute of Standards and Technology.

C. Provide complete documentation covering the traceability of all calibration instruments.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 17050

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration

3.04 CLEANING

A. Refer to Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. Refer to Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

1. Furnish 8 hours of OWNER training.

3.06 PROTECTION

A. Refer to Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications, or both.

END OF SECTION

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SECTION 17501

ANALYZERS – PH GENERAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. pH instruments.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.03 DEFINITIONS

A. As specified in Section 17050.

B. NEMA:

1. Type 4X enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 17050.

B. Test Reports:

1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration:

a. Include factory calibration for each instrument with stated accuracy.

C. Operating Manuals:

1. Certified factory and field calibration data sheets for instruments and devices that require set-up and calibration:

a. Include factory calibration for each instrument with stated accuracy.

2. Complete installation, calibration, and testing manuals.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Shall be one of the following to match Owner Standard:

1. Rosemount:

a. Sensor Model 3900.

b. Transmitter Model 1056.

2. Rosemount:

a. Sensor Model 3900.

b. Transmitter Model 1057.

B. All instruments of similar nature must be furnished by the same manufacturer.

2.02 MANUFACTURED UNITS

A. pH Analyzers:

1. General:

a. pH measurement shall use the potentiometric measurement method utilizing a glass electrode. The pH sensitive glass membrane surface reacts to the acid content of the solution with a specific voltage, which is measured relative to a reference electrode.

2. Performance Requirements:

a. Accuracy: ±0.01 pH.

b. Stability: ±0.01 pH/month.

c. Repeatability: ±0.01 pH.

3. Element:

a. Sensor Material:

1) Glass pH sensor housed in a molded reinforced polypropylene body threaded for insertion, submersion, or flow-through installation as identified on the drawings and/or instrument data sheets.

2) Built in temperature sensor.

3) The reference electrode junction shall be capable of maintaining steady reference signal by resisting plugging in dirty applications.

b. pH Measuring Range: 0 to 14 pH.

c. Temperature Measuring Range: 0 to 70 degrees Celsius.

d. Operating Temperature Range: 0 to 80 degrees Celsius.

e. Operating Pressure Range: 0 to 87 psi.

f. Connections:

1) Process: as shown in the Instrument Data Sheets.

g. Power supply:

1) 120 VAC.

2) Power consumption: 15 VA maximum.

h. Outputs:

1) 2 isolated 4-20 mA DC with HART communication protocol.

a) Proportional to pH and temperatures.

i. Display:

1) Backlit LCD digital display.

j. Measurement Ranges: 0 to 14 pH.

k. Temperature: 0 to 50 degrees Celsius.

l. Displayed Resolution: ±0.01 pH.

m. Ambient Conditions:

1) Operable from 0 to 50 degrees Celsius.

2) Relative Humidity 0 to 95 percent.

n. Mechanical:

1) Enclosure rating:

a) NEMA Type 4X (IP65).

2) Mounting:

a) Panel mount suitable for mounting in an enclosure that includes gasket to maintain weather rating of the panel.

b) Surface mount enclosures, include self-tapping screws.

c) Pipe mounting accessories shall be included for mounting enclosures to a 2-inch pipe.

3) Provide all mounting hardware for proper installation and servicing of the sensor assembly.

o. Electrical Certification: NRTL certified to UL and CSA standards, and CE approved.

4. Components:

a. Sensor Cable:

1) Shall be provided with watertight sensor-to-cable connector that prevents cable twisting and eliminates rewiring when replacing the sensor.

2) Cable Length: As required to connect sensor to transmitter plus 10 percent.

3) Provide cable from sensor manufacturer without splices.

2.03 ACCESSORIES

A. Sensor:

1. Process Assemblies:

a. As specified on Instrument Data Sheets.

B. Transmitter:

1. HART compatible with DTM.

2. Flat gasket.

3. Stainless steel tag:

a. Marking specified on Instrument Data Sheets.

C. Preamplifier:

1. Use Manufacturer recommended preamplifier on coaxial cable runs longer than 15 feet.

D. Provide a sun shield for outdoor applications.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

B. Factory calibrate all instruments and/or representative instruments at a facility that is traceable to the National Institute of Standards and Technology (NIST):

1. Provide complete documentation covering the traceability of all calibration instruments.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

C. Install sensor in pipe that is fully submerged.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory-calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 8 hours of OWNER training.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications or both.

END OF SECTION

SECTION 17505

ANALYZER – RESIDUAL CHLORINE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Residual chlorine analyzers.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. Refer to Section 17050.

1.03 DEFINITIONS

A. Refer to Section 17050.

1.04 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. Refer to Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. Refer to Section 17050.

1.08 WARRANTY

A. Refer to Section 17050.

1.09 MAINTENANCE

A. Refer to Section 17050.

B. Furnish all parts, materials, fluids, etc. necessary for maintenance and calibration purposes for a period of one year:

1. Deliver all supplies for substantial completion.

C. Provide the following:

1. 1-year supply of standards, reagents, and cleaning solutions, based on Manufacturer's recommendations.

2. Spare pump tubing, caps, funnels, fittings for each analyzer, in order to perform recommended maintenance for 1 year.

3. Spare colorimeter lamp assembly for each analyzer.

D. Provide the following:

1. Spare tubing, caps, funnels, fittings for each analyzer, in order to perform recommended maintenance for 1 year.

2. Three spare membranes for each sensor.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Chlorine residual monitoring systems:

1. Siemens Wallace & Tiernan MFC Electronic Module Controller with Depolox 5 Flow Cell with Free Chlorine residual monitoring sensor, or equal.

2.02 MANUFACTURED UNITS

A. Sensor: Chlorine sensor shall be a flow through cell featuring integral, bare-electrode measurement for free chlorine. Sensor range to be 0.0 to 2.0 mg/L of free chlorine. Sensor shall be equipped with integral flow control valve, to maintain

sample flow of 0.15 GPM with inlet pressure of 3 to 60 PSI. Controller: The controller shall be an electronic module. The electronic module shall accept 4 input sensor modules to accommodate multiple measurement requirements. Controller shall be equipped with four 4-20 mA outputs and eight relays. Provide Fail status alarm contact and a Loss of Flow alarm contact for each sensor on the controller. Controller shall be in NEMA 4 enclosure.

2.03 SOURCE QUALITY CONTROL

A. Refer to 17050.

B. Provide complete documentation covering the traceability of all calibration instruments.

C. Submit a real-time computer generated printout of the actual calibration data indicating apparent and actual residuals at 20 percent, 40 percent, 60 percent, 80 percent, and 100 percent of the calibrated range to the ENGINEER at least 30 days before shipment of the meters to the project site.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. Refer to Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. Refer to Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 8 hours of OWNER training.

3.06 PROTECTION

A. Refer to Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications or both.

END OF SECTION

SECTION 17507

ANALYZER – FLUORIDE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Fluoride analyzers.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. Refer to Section 17050.

B. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

1.03 DEFINITIONS

A. Refer to Section 17050.

B. NEMA:

1. Type 4X enclosure in accordance with NEMA 250.

1.04 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. Refer to Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. Refer to Section 17050.

1.08 WARRANTY

A. Refer to Section 17050.

1.09 MAINTENANCE

A. Refer to Section 17050.

B. Furnish all parts, materials, fluids, etc. necessary for maintenance and calibration purposes for a period of one year:

1. Deliver all supplies for substantial completion.

C. Provide the following:

1. 1-year supply of standards, reagents, Formic Acid, reference electrode filling solution, pipette, pipette tips based on Manufacturer's recommendations.

2. Spare tubing, caps, O-rings, restriction tubing, check valve, inlet filter for each analyzer, in order to perform recommended maintenance for 1 year.

3. Electronics faceplate, air pump, regulatory assembly, electrode cable with gland assemblies, power supply and fuse kit based on Manufacturer's recommendation

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Fluoride monitoring system shall be:

1. Thermos Scientific Orion 2109XP Fluoride Analyzer or equal.

2.02 MANUFACTURED UNITS

A. Fluoride Analyzer::

1. General:

a. Measurement of Fluoride ions in water using an ion selective electrode (ISE), an ASTM approved method (ASTM D-1179-72 Method B). Utilizing a sensing electrode, reference probe, pH reagent and temperature probe within a flow cell. The sensing electrode responds logarithmically to changes in fluoride ion concentration. Calibrations are performed using Double Known Addition (DKA) which has the distinct advantages of being fast, easy and accurate.

2. Performance Requirements:

a. Range: 10 ppb – 200 ppm (auto ranging)

b. Accuracy: +/- 10% or 10ppb, whichever is greater

c. Waterproof Enclosure: IP66 and NEMA 4X

d. Ambient Temperature: 5 to 45 ˚C

e. Non-volatile Memory/Battery Backup/Data Logging

f. Process:

1) Inline

2) As shown per Manufacturer's installation

3) Temperature 5 to 35˚C

4) Inlet Pressure: 8 to 100 psig

5) Flow Rate: 40mL/minute nominal, set by pressure regulator

g. Power Input: 85-132VAC; 200ma 50 to 60 HZ

h. Outputs:

1) (2) galvanically isolated 4 to 20 mA

2) Programmable Range

3) Log and Linear Output Options

4) Channel Assignments: Fluoride and Temperature

5) Relative Accuracy: +/- (0.05mA +0.5%)

6) Number of relay outputs: (3) 250VAC/5A resistive load only

7) Programmable Min and Max Values

i. Display:

1) Custom backlit LCD

2) Keypad: 8 electromechanical keys with graphic overlay

j. Software Features:

1) Self- test and Diagnostics

2) Real Time Clock

3) Reset Function

4) Programmable Alarms – High, Low, error, calibration/offline

5) Measurement Active: Signal noise, temperature

6) Calibration: Sensor response, drift, E0, slope, temperature

2.03 SOURCE QUALITY CONTROL

A. Refer to Section 17050.

B. Factory calibrate all instruments and/or representative instruments at a facility that is traceable to the National Institute of Standards and Technology (NIST). Provide complete documentation covering the traceability of all calibration instruments.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions.

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. Refer to Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. Refer to Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 8 hours of OWNER training.

3.06 PROTECTION

A. Refer to Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications or both.

END OF SECTION

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SECTION 17509

ANALYZERS - TURBIDITY

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Turbidity analyzers (turbidimeters).

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. Refer to Section 17050.

1.03 DEFINITIONS

A. Refer to Section 17050.

1.04 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 17050.

B. Factory 5-point calibration for each analyzer with stated accuracy.

1.05 QUALITY ASSURANCE

A. Refer to Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the process.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. Refer to Section 17050.

1.08 WARRANTY

A. Refer to Section 17050.

1.09 MAINTENANCE

A. Refer to Section 17050.

B. Furnish all parts, materials, fluids, etc. necessary for maintenance and calibration purposes for a period of one year:

1. Deliver all supplies before substantial completion.

C. Provide Calibration Cubes for each instrument, except where not available from the manufacturer. (If applicable).

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Low Range Turbidimeters - Incandescent type:

1. HACH 1720E sensor with sc200 controller.

B. Turbidimeters - Laser type:

1. HACH - Filter Trak 660 with sc200 controller.

2.02 MANUFACTURED UNITS

A. Low Range Turbidimeters - Incandescent type:

1. Turbidimeter:

a. The turbidimeter shall be a microprocessor-based, continuous-reading, on-line nephelometric instrument meeting all design and performance criteria specified by USEPA method 180.1. Each turbidity system shall consist of a one sensor and one transmitter.

b. Light shall be directed through the surface of the sample and the detector shall be immersed in the sample, eliminating glass windows and flow cells.

c. Optical components shall be mounted in a sealed head assembly that can be removed easily for calibration/service, without disturbing sample flow.

d. The turbidimeter body shall be constructed of corrosion-resistant polystyrene, and shall include an internal bubble trap to vent entrained air from the sample stream.

e. The turbidimeter shall offer the choice of Formazin-based (20 or 1 NTU) or instrument comparison-based calibration methods.

f. User selectable signal averaging, bubble rejection, alarm, and recorder output hold, and self-test diagnostics shall be provided.

2. Performance requirements:

a. Range: 0 to 10 nephelometric turbidity units (NTU).

b. Accuracy:

1) ±2 percent of reading or ±0.020 NTU (whichever is greater) from 0 to 40 NTU.

2) ±5 percent of reading from 40 to 100 NTU.

c. Resolution: 0.001 NTU.

d. Repeatability: Better than ±1.0 percent of reading or ±0.020 NTU, whichever is greater.

e. Response Time:

1) Initial response in 1 minute.

2) 15 seconds with internal bubble trap.

f. Sample Flow Required: 250 to 750 mL/minute (4.0 to 11.9 gal/hour).

g. Storage Temperature: -20 degrees Celsius to 60 degrees Celsius (- 4 degrees Fahrenheit to 140 degrees Fahrenheit).

h. Operating Temperature: 0 degrees Celsius to 40 degrees Celsius (32 degrees Fahrenheit to 104 degrees Fahrenheit).

i. Operating Humidity: 5 to 95 percent non-condensing.

j. Sample Temperature: 0 degrees Celsius to 50 degrees Celsius (32 degrees Fahrenheit to 122 degrees Fahrenheit).

3. Transmitter:

a. The graphical interface unit shall be a microprocessor-based device capable of functioning with a single sensor, and as a digital interface link between turbidimeters and other communication devices through a digital bus communications.

b. All turbidimeters on the network shall have RS232 serial input/output capability for two-way communication to a computer or one-way communication to a printer to record or print real-time turbidity data, calibration history, and current set points.

c. The interface unit shall allow operators to control sensor and network functions with user-friendly, menu-driven software, and shall provide data logging of measurement data from up to eight turbidimeters for 1 hour, 24 hours or 30 days, and the capability to transfer data to a computer or printer via an RS232 serial input/output device.

d. The interface unit and separate DC power supply shall be housed in NEMA-4X (indoor) industrial plastic enclosures.

e. Piping Connections:

1) Sample Inlet Fitting: 1/4 inch NPT female, 1/4 inch compression fitting.

2) Drain fitting 1/2 inch NPT female, 1/2 inch hose barb.

f. Communications Distance:

1) Maximum node-to-node distance: 400 meters (1312 feet).

2) Maximum total cable length: 500 meters (1640 feet).

g. Enclosures NEMA 4X/IP66.

h. Certification:

1) Safety Listed by ETL to UL3101-1.

2) Certified by ETL to CSA C22.2 No. 1010.1.

3) CE Certified by Hach Company to EN 61010-1.

4) Emissions FCC Part 15, Class A Canadian Interference-Causing Equipment Regulation ICES-003, Class A.

i. Power supply:

1) 120 VAC.

2) Power consumption: 40 VA maximum.

j. Outputs:

1) Isolated 4-20mA DC with HART communication protocol.

2) MODBUS communication protocol.

3) Relay outputs:

a) 2 Form C contact.

b) Rated 5 amps at 230 VAC.

c) Programmable.

4) Output span programmable over any portion of the 0 to 10 NTU range.

B. Low Range Turbidimeters - Laser type:

1. General:

   a. The turbidimeter shall be a microprocessor-based, continuous-reading, on-line nephelometric instrument meeting all design and performance criteria specified by USEPA method 180.1. Each turbidity system shall consist of a one sensor and one transmitter.

   b. Optical components shall be mounted in a sealed head assembly that can be removed easily for calibration/service, without disturbing sample flow.

   c. The turbidimeter body shall be constructed of corrosion-resistant polystyrene, and shall include an internal bubble trap to vent entrained air from the sample stream.

2. Performance requirements:

   a. Range: 0.000 to 1,000 milli nephelometric turbidity units (mNTU).

   b. Accuracy:

      1) ±5 percent of reading or ±5 mNTU whichever is greater.

   c. Resolution: 0.001 mNTU.

   d. Repeatability: ±3.6 percent of reading at 30 mNTU or ±1.7 percent of reading at 800 mNTU.

   e. Sample Flow Required: 100 to 750 mL per minute (4.0 to 11.9 gallon per hour).

3. Transmitter:

   a. The graphical interface unit shall be a microprocessor-based device capable of functioning in with a single sensor, and as a digital interface link between turbidimeters and other communication devices through a digital bus communications.

   b. The interface unit shall allow operators to control sensor and network functions with user-friendly, menu-driven software, and shall provide data logging of measurement data, and the capability to transfer data to a computer or printer via an RS-232 serial input/output device.

   c. The interface unit shall be housed in NEMA-4X (indoor) industrial plastic enclosures. Operating Humidity: 5 to 95 percent non-condensing.

   d. All turbidimeters on the network shall have RS-232 serial input/output capability for two-way communication to a computer or one-way communication to a printer to record or print real-time turbidity data, calibration history and current set points.

   e. Microprocessor-based signal converter/transmitter. Each instrument shall have the following:

   f. Enclosures NEMA-4X/IP66.

g. Certification:

1) USEPA - Federal Register Vol 67 No. 209.

h. Power supply:

1) 120 VAC.

2) Power consumption: 35 VA maximum.

i. Outputs:

1) Isolated 4-20mA DC with HART communication protocol.

a) 2 Form C contact.

b) Rated 5 amps at 120 VAC.

c) Programmable.

2.03 ACCESSORIES

A. Mounting brackets as required or as indicated on the Drawings.

B. Provide sun shield for outdoor installations.

C. Flushing solenoids for cleaning the probe as recommended by the manufacturer.

2.04 SOURCE QUALITY CONTROL

A. Refer to Section 17050.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Section 17050.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. Refer to Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. Refer to Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 8 hours of OWNER training.

3.06 PROTECTION

A. Refer to Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications or both.

END OF SECTION

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SECTION 17601

DETECTION SYSTEMS – CHLORINE GAS MONITOR

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Chlorine Gas Detectors.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 17050.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
2. Physical conditions:
   a. Installation and mounting requirements.
   b. Location within the process.
   c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

B. Furnish all parts, materials, fluids, etc. necessary for maintenance and calibration purposes for a period of one year:
   1. Deliver all supplies for substantial completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Chlorine gas detection systems:
   1. Analytical Technology, GasSens Model A14/A11 monitoring with dual sensors for protection and monitoring, or equal

2.02 MANUFACTURED UNITS

A. General: A modular chlorine gas monitoring system comprising of a power supply, two receiver modules, NEMA 4X enclosure(s) and two sensor/transmitters to measure gas concentration within a space and provide protective functions and gas level concentration level.
   1. Power Supply:
      a. The power supply in the receiver module shall be a modular design providing 12 VDC power to up to two receiver modules. A third DC output shall be provided to float charge a standby battery system to provide battery backup to the entire detection system in the event of power failure. The power supply shall be capable of operation from any voltage from 85-250 volts, AC or DC, without adjustment,

and shall also contain a power failure relay for remote power failure indication.

2. Receiver Module:

a. The receiver module shall provide a high intensity digital LED display of gas concentration, plus alarm indicator LED's for Warning, Alarm, and Trouble. Two programmable alarm set points shall be provided for warning personnel of differing levels of leakage. Gas leak alarms shall be indicated by flashing LED indicators on the alarm receiver and activation of the audible horn. The concentration of the gas shall be displayed directly in PPM units. Three alarm relays shall be provided for external alarming functions. Each alarm relay shall be independently assignable to either the low or the high alarm set point, and shall also be programmable for latching and/or fail-safe operation. In addition, a separate Trouble alarm shall be provided on each receiver to indicate the loss of signal from the sensor/transmitter, or to alarm the loss of sensitivity of the gas sensor if Auto-Test is supplied on the sensor. Each receiver shall provide an isolated 4-20 mA output signal proportional to gas concentration, and shall also contain remote reset input terminals to allow alarm acknowledgment from a remote location.

3. Sensor/Transmitters shall be electrochemical gas sensors which convert measured gas concentration to a digital signal for transmission to a receiver module up to a minimum of 1000 feet of two conductor cable. Sensor range to be 0.0 to 5.00 ppm and 0.0 to 25.00 ppm respectfully.

2.03 ACCESSORIES

A. Gas Generator:

1. Each sensor/transmitter shall be supplied with an electrochemical gas generator closely coupled to the sensor which shall automatically generate a small concentration of gas every 24 hours to verify sensor operation. During the verification test, alarm relays shall be inhibited. Should the sensor not respond to the gas test, the Trouble alarm on the receiver shall be activated.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

B. Provide complete documentation covering the traceability of all calibration instruments.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory-calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 8 hours of OWNER training.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications or both.

END OF SECTION

SECTION 17602

TEMPERATURE MEASUREMENT - AMBIENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Ambient air temperature instrument.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 17050.

B. Furnish complete Product Data, Shop Drawings, Operating Manuals, Record Drawings, Manufacturer's certifications and other submittals as specified in Section 17050.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

B. Examine the complete set of Contact Documents and verify that the instruments are compatible with the installed conditions including:

1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:

a. Installation and mounting requirements.

b. Location within the rooms.

c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the ENGINEER if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.08 WARRANTY

A. As specified in Section 17050.

1.09 MAINTENANCE

A. As specified in Section 17050.

B. Furnish all parts, materials, fluids, etc. necessary for maintenance and calibration purposes for a period of one year:

1. Deliver all supplies for substantial completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Ambient Air Temperature Sensor:

1. Comet Systems T0610 with PoE, or equal

2.02 MANUFACTURED UNITS

A. General: An ambient air temperature measuring instrument shall use an RTD temperature element, display temperature and transmit data via PoE

1. Performance requirements:

a. Accuracy: +/- 0.6°C.

b. Humidity operating range without condensation 0 to 100% RH

2. RTD Pt1000 temperature sensor with stainless steel mesh of 0.025mm.
3. LCD Display
4. Power over Ethernet (PoE) according to IEEE 802.3af
5. IP 30.

B. Two year warranty

2.03 ACCESSORIES

A. None.

2.04 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

B. Provide complete documentation covering the traceability of all calibration instruments.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

3.02 FIELD QUALITY CONTROL

A. As specified in Section 17050.

B. Provide manufacturer's services to perform start-up and calibration or verification.

3.03 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:

1. Return factory-calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.04 CLEANING

A. As specified in Section 17050.

3.05 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Demonstrate performance of all instruments to the ENGINEER before commissioning.

C. Furnish 1 hour of OWNER training.

3.06 PROTECTION

A. As specified in Section 17050.

3.07 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:

1. Instruments may be shown on the Drawings, in the Specifications or both.

END OF SECTION

SECTION 17710

CONTROL SYSTEMS – PANELS, ENCLOSURES AND PANEL COMPONENTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Design, fabrication and assembly of all instrumentation enclosures, control panels and components provided under this contract, including but not limited to:

   a. Custom built instrumentation and control panels, including PCMs, RTUs, LCPs, instrument junction boxes (IJBs), and power junction boxes (PJBs).

   b. Control panels furnished as part of equipment systems specified in other Divisions, such as vendor control panels (VCPs) and chemical feed panels.

   c. Control components.

   d. Control panel installation.

2. SCADA software licenses.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

   a. Section 01330 - Submittal Procedures.

   b. Section 01900 - Seismic Design Criteria.

   c. Section 16050 - Common Work Results for Electrical.

   d. Section 16075 - Electrical Identification.

   e. Section 16262 - Variable Frequency Drives 0.50 - 50 Horsepower.

   f. Section 16412 - Low Voltage Molded Case Circuit Breakers.

   g. Section 16422 - Motor Starters.

   h. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.02 REFERENCES

A. As specified in Section 17050.

B. Specific references:

1. National Electrical Manufacturer's Association (NEMA):

a. NEMA 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

b. NEMA ICS 6 - Enclosures for Industrial Control and Systems.

2. Underwriters Laboratories Inc. (UL):

a. UL 50 - Enclosures for Electrical Equipment.

b. UL 508 - Industrial Control Equipment.

c. UL 508A - Standard for Industrial Control Panels

1.03 DEFINITIONS

A. As specified in Section 17050.

B. Specific definitions:

1. The term “panel” in this Section is interchangeable with the term “enclosure.”

1.04 SYSTEM DESCRIPTION

A. Panel Dimensions:

1. Minimum dimensions are scalable from or as indicated on the Drawings and are based upon manufacturer’s non-certified information. It is the responsibility of the Contractor or Manufacturer to design and size all panels:

a. Size panels to provide space for all equipment, wiring, terminations, and other items in the panel, including space for future build out.

b. Panel sizes that substantially deviate (±3 inches in any dimension) from the sizes shown on the Drawings shall be approved by the ENGINEER.

c. Maximum panel depth: 30 inches, unless otherwise indicated.

B. Structural Design:

1. Completed and installed panel work shall safely withstand seismic requirements at the project site indicated in Section 16050. Enclosures and internal equipment shall be braced to prevent damage from specified forces.

1.05 SUBMITTALS

A. Provide submittals in accordance with Sections 01330 and 17050.

B. Provide a control panel hardware submittal, for each control panel and enclosure being provided on this project, including but not limited to:

1. Product Data:

   a. Enclosure construction details and NEMA type.

   b. Manufacturer's literature and specification data sheets for each type of equipment to be installed within or on the panel or enclosure.

2. Shop Drawings:

   a. Scaled, detailed exterior panel (front and side views) and interior panel layout showing equipment arrangement and dimensional information:

      1) Provide draft for review and approval by ENGINEER. The ENGINEER has the authority to substantially alter initial panel layouts.

   b. Complete nameplate engraving schedule.

   c. Structural details of fabricated panels.

3. Calculations:

   a. Provide installation details based on calculated shear and tension forces:

      1) Calculations shall be signed and sealed by a Professional Engineer licensed in the state where the cabinets and panels will be installed.

   b. For assembled enclosures and other equipment with a weight of 200 pounds or more, provide calculations for:

      1) Weight including panel internal components.

      2) Seismic forces and overturning moments.

      3) Shear and tension forces in connections.

   c. Cooling Calculations, to include but not limited to:

      1) Highest expected ambient temperature for the enclosure's location

      2) Internal heat load.

      3) Exposure to direct sunlight.

      4) Dimensions of the enclosure in inches.

      5) Maximum allowable temperature inside the enclosure, based on the lowest operating temperature limit of the installed components.

C. Seismic Design:

1. Seismic Panel Construction:

   a. Seismic Anchorage: Provide seismic design calculations and installation details for anchorage of all panels, enclosures, consoles, etc. to meet seismic requirements in Section 01900:

1) Stamped by a Professional Engineer registered in the state where the project is being constructed.

b. For floor mounted free standing panels weighing 200 pounds or more (assembled, including contents), submit calculations, data sheets, and other information to substantiate that panel, base, and framing meet minimum design strength requirements and seismic requirements per Section 01900. Calculations shall be signed and sealed by a Professional Engineer licensed in the state where the cabinets and panels will be installed.

1.06 QUALITY ASSURANCE

A. Refer to Section 17050.

B. Assemble panels, enclosures, and rack systems along with all internal and external devices, wiring, equipment, and materials in a facility that is recognized by Underwriters Laboratories to assemble and certify UL-labeled control panels:

1. Provide all components and equipment with UL 508 listing.

2. All control panels shall be UL 508A labeled, unless the equipment in the panel and the design in the contract documents cannot be reasonably modified to meet the requirements for UL508A labeling:

a. Non-listed, complex and unique equipment may be evaluated and approved by a third party testing agency, with prior approval by the OWNER. Provide report documenting the testing standard, specification, method of testing and that the equipment and materials meet appropriate designated standards or have been tested and found suitable for use in a specified manner.

3. Provide fuses for all equipment that is not UL or UR listed.

1.07 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 17050.

B. Crate all panels for shipment using a heavy framework and skids:

1. Provide factory-wrapped waterproof flexible barrier material for covering materials, where applicable, to protect against physical damage in transit.

2. Provide suitable shipping stops and cushioning material for all instruments shipped with the panel to prevent damage due to mechanical shock during shipment.

3. Provide each separate panel unit with removable lifting lugs to facilitate handling.

C. Ship all panels by dedicated air ride van, unless otherwise specified or approved.

1.08 PROJECT OR SITE CONDITIONS

A. Refer to Section 17050.

B. Provide enclosures suitable for the location and environmental conditions in which they are located, and in the NEMA types in accordance with Section 16050, unless otherwise indicated.

1.09 WARRANTY

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. As listed below in the individual component paragraphs.

B. Provide instruments and other components performing similar functions of the same type, model, or class, and from one Manufacturer.

2.02 MATERIALS

A. Construct and finish enclosures using materials capable of withstanding the mechanical, electrical, and thermal stresses, as well as the effects of humidity and corrosion that are likely to be encountered in normal service:

1. Enclosures shall have the following properties:

a. NEMA Type 1: Steel.

b. NEMA Type 4: Steel with gasketed door, rain tight.

c. NEMA Type 4X: Stainless steel 316 (unless indicated 304 on the drawings).

d. NEMA Type 4X: polycarbonate or fiberglass reinforced polyester (FRP) in corrosive areas where stainless steel is incompatible.

e. NEMA Type 12: Steel with gasketed door, dust-tight.

f. NEMA Type 7: Cast aluminum.

B. Bolting Material:

1. Commercial quality 1/2-inch diameter, stainless steel hex-head grade 5 bolts, nuts and washers, with unified coarse (UNC) threads.

2. Carriage bolts for attaching end plates.

3. All other bolted joints shall have S.A.E. standard lock washers.

2.03 MANUFACTURED UNITS

A. Panels/Enclosures:

1. Manufacturers: One of the following:

a. Hoffman Proline, or equal.

2. Panel assembly:

a. General guidelines for panel fabrication include:

1) Continuous welds ground smooth.

2) Exposed surfaces free of burrs and sharp edges.

3) Base formed of heavy channel iron, either galvanized or powder coated, minimum 1/2 inch holes at 12 inch spacing

to accommodate anchoring of freestanding enclosures to floor.

b. Construct enclosure and mounting panel using stretcher level quality sheet metal having minimum thickness not less than the following sizes (U.S. Standard Gauge):

Enclosure Height (inches)	Minimum Enclosure Steel Thickness (gauge)	Minimum Back Mounting Panel Thickness (gauge)
Up to 57	12	12
57 - 69	12	10
69 - 82	12, except 10 on back	10
82 or more	10	10

1) Use heavier sheet metal to meet seismic requirements at the project site or when required due to equipment requirements.

c. Construct supporting frame structure with angled, channeled, or folded rigid section of sheet metal, rigidly attached to and having essentially the same outer dimensions as the enclosure surface and having sufficient torsional rigidity to resist the bending moments applied via the enclosure surface when it is deflected.

d. Provide stiffeners for back mounting panels in enclosures larger than 4 feet. In addition, secure the panels in place by collar studs welded to the enclosure.

e. Door construction:

1) Turned-back edges suitably braced and supported to maintain alignment and rigidity without sagging.

2) Sufficient width to permit door opening without interference with rear projection of flush mounted instruments.

3) Heavy gauge piano type continuous stainless steel hinges.

4) For NEMA Type 12, Type 4 and Type 4X, provide oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.

5) Gasket installed to seal against roll lip on the enclosure opening.

f. Latches:

1) For panels each door provided with a 3-point latching mechanism and locking handle with rollers on the ends of the latch rods. Latch rods connected to a common door handle, hold doors securely, forming a compressed seal between door and gasket, at the top, side, and bottom.

a) Provide padlock for each enclosure with padlock provisions.

2) Include an oil-tight key-locking, 3-point latching mechanism on each door:

a) Provide 2 keys per panel.

b) All locks keyed alike.

3) For large type NEMA Type 4 and NEMA Type 4X cabinets, not available with 3-point latching hardware, provide multiple clips and padlock hasps.

4) Provide quick release latches for all NEMA Type 4 and Type 4X enclosures.

g. Panel cut-outs:

1) Cut, punch, or drill cutouts for instruments, devices, and windows. Smoothly finish with rounded edges.

2) Allow a minimum of 3-inch envelope around all displays, controllers, and monitors.

3) Reinforce around cut-outs with steel angles or flat bars for the following:

a) Large panel cutouts; for example, openings for local operator interfaces.

b) Pilot device groupings, where the removed metal exceeds 50 percent of the available metal.

3. In addition to the requirements specified above the following requirements for NEMA Type 4X powder coated stainless steel enclosures apply:

a. Minimum 14 gauge, Type 304.

b. Captive stainless steel cover screws threaded into sealed wells.

c. Finish: white polyester powder coating.

d. Specifically designed for use with flange-mounted disconnect handles where required or as indicated on the Drawings.

e. NEMA Type 4X powder coated stainless steel enclosures are not an acceptable substitute for stainless steel unless indicated on the Drawings.

4. In addition to the requirements specified above the following requirements apply for NEMA Type 4X non-metallic enclosures:

a. Fiberglass construction.

b. 10 gauge plate steel reinforcing on the sides, top, and bottom.

c. All seams sealed.

d. Fiberglass hinges with no exposed metal parts.

e. Captivate stainless steel door screws.

f. Provisions for internal, sidewall, mounting panels either by welded channels to the interior, or by welded collar studs.

g. Provide aluminum mounting panels.

h. Non-metallic enclosures are not an acceptable substitute for stainless steel unless indicated on the Drawings.

5. Outdoor Panels. Supplementary requirements for panels located outdoors are as follows:

a. All enclosures located outdoors shall be explicitly designed and rated for outdoor service by the manufacturer.

b. Door hardware: stainless steel.

c. Provide rain canopy and sun shield.

d. Bases: Heavy channel, gasketed iron bases, flanges up, for anchoring to pad.

B. Arrangement of Components:

1. Arrange panel internal components for external conduit and piping to enter into panel either from above or below.

2. Arrange panel instruments and control devices in a logical configuration associating pushbutton and selector switches with related readout devices, or as indicated on the Drawings.

3. Mount internal control components on an internal back-panel. Devices may be mounted on the side-panel only by special permission from the ENGINEER.

4. All control panel mounted operator interface devices shall be mounted between 3 feet and 6 feet above finished floor.

C. Overcurrent Protection:

1. Main overcurrent device:

a. Where the electrical power supply voltage to the control panel is more than 120 VAC, provide the panel with a flange mounted disconnect handle operating a molded case circuit breaker, and provide a control power transformer for 120 VAC circuits:

1) Door-mounted disconnect handles are not acceptable.

2) Mechanically interlocked the disconnect switch with the control enclosure doors so that no door can be opened unless the power is disconnected, and the disconnect switch cannot be closed until all doors are closed.

3) Provide means to defeat the interlock.

4) Lockable in the off position.

b. Control panels supplied with 120 VAC:

1) Provide an internal breaker with the line side terminals covered by a barrier.

2) Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a

warning statement requiring the source to be disconnected before opening the door to the enclosure.

2. Provide circuit breakers in accordance with Section 16412.
3. Selection and ratings of protective devices:
    a. Interrupting ratings: Not less than the system maximum available fault current at the point of application.
    b. Voltage rating: Not less than the voltage of the application.
    c. Select current rating and trip characteristics to be suitable for:
        1) Maximum normal operating current.
        2) Inrush characteristics.
        3) Coordination of the protective devices to each other and to the source breaker feeding the panel.
4. Provide a separate protective device for each powered electrical device:
    a. An individual circuit breaker for each 120 VAC instrument installed within its respective control panel and clearly identified for function.
    b. An individual fuse for each PLC discrete output. Provide with individual fuse with blown fuse indication external of the I/O card:
        1) Size external fuse to open before any I/O card mounted fuses.
    c. An individual 5-ampere fuse for each discrete input loop.
    d. An individual 1/2-ampere fuse for each 4-20 mA analog loop powered from the control panel.
    e. Install protective devices on the back mounting panel and identify by a service nameplate in accordance with the wiring diagrams.
5. Fuses:
    a. Provide durable, readily visible label for each fuse, clearly indicating the correct type, size, and ratings of replacement fuse:
        1) Label shall not cover or interfere with equipment manufacturer's instructions.
    b. Provide fuses rated for the voltage and available short circuit current at which they are applied.
    c. Provide UL listed RK1 dual-element, time-delay fuses with ampere ratings as indicated on the Drawings or as required for the application.
    d. Manufacturer: One of the following:
        1) Ferraz Shawmut.
        2) Littelfuse.
        3) Bussmann.

6. Fuse holders:
    a. Modular type:
        1) DIN rail mounting on 35 mm rail.
        2) Touch safe design: All connection terminals to be protected against accidental touch.
        3) Incorporates blown fuse indicator.
    b. Provide nameplate identifying each fuse:
        1) In accordance with Section 16075.
    c. Manufacturer: One of the following:
        1) Phoenix Contact.
        2) Allen Bradley 1492-FB Series B.
7. Control Circuit Breakers:
    a. DIN rail mounting on 35 mm rail.
    b. Manual OPEN-CLOSE toggle switch.
    c. Rated 250 VAC.
    d. Interrupting Rating: 10 kA or available fault current at the line terminal, whichever is higher.
    e. Current ratings: As indicated on the Drawings or as required for the application.
    f. Provide nameplate identifying each circuit breaker:
        1) In accordance with Section 16075.
    g. Manufacturer: One of the following:
        1) Phoenix Contact.
        2) ABB.
        3) Allen Bradley Series.
        4) Square D.

D. Conductors and Cables:
1. Power and Control Wiring:
    a. Materials: Stranded, soft annealed copper.
    b. Insulation: 600 V type MTW.
    c. Minimum Sizes:
        1) Primary power distribution: 12 AWG.
        2) Secondary power distribution: 14 AWG.
        3) Control: 16 AWG.
    d. Color:
        1) AC power (line and load): BLACK.

2) AC power (neutral): WHITE.

3) AC control: RED.

4) DC power and control (ungrounded): BLUE.

5) DC power and control (grounded): WHITE with BLUE stripe.

6) Ground: GREEN.

2. Signal Cables:

a. Materials: Stranded, soft annealed copper.

b. Insulation: 600 V, PVC outer jacket.

c. Minimum Size: 16 AWG paired triad.

d. Overall aluminum shield (tape).

e. Copper drain wire.

f. Color:

1) 2 Conductor:

a) Positive (+): BLACK.

b) Negative (-): WHITE, RED.

2) 3 Conductor:

a) Positive (+): BLACK.

b) Negative (-): RED.

c) Signal: WHITE.

g. Insulate the foil shielding and exposed drain wire for each signal cable with heat shrink tubing.

E. Conductor Identification:

1. Identify all conductors and cables with wire markers in accordance with Section 16075.

2. Readily identified without twisting the conductor.

F. General Wiring Requirements:

1. Wiring Methods: Wiring methods and materials for panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise specified.

2. Install all components in accordance with the manufacturer's instructions included in the listing and labeling.

3. Control panels supplied with 120 VAC:

a. Provide an internal breaker with the line side terminals covered by a barrier.

b. Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning

statement requiring the source to be disconnected before opening the door to the enclosure.

4. Provide a nameplate on the cover of the control panel identifying all sources of power supply and foreign voltages within the control panel.

5. Provide transformers, protective devices, and power supplies required to convert the supply voltage to the needed utilization voltage.

6. Provide surge protection for panels unless they are located in the same building as the source distribution equipment. Provide nonmetallic ducts for routing and organization of conductors and cables:

   a. Size ducts for ultimate build-out of the panel, or for 20 percent spare, whichever is greater.

   b. Provide separate ducts for signal and low voltage wiring from power and 120 VAC control wiring:

      1) 120 VAC: Grey colored ducts.

      2) 24 VDC: White colored ducts.

7. Cables shall be fastened with cable mounting clamps or with cable ties supported by any of the following methods:

   a. Screw-on cable tie mounts.

   b. Hammer-on cable tie mounting clips.

   c. Fingers of the nonmetallic duct.

8. The free ends of cable ties shall be cut flush after final adjustment and fastening.

9. Provide supports at the ends of cables to prevent mechanical stresses at the termination of conductors.

10. Support panel conductors where necessary to keep them in place.

11. Wiring to rear terminals on panel-mount instruments shall be run in nonmetallic duct secured to horizontal brackets run adjacent to the instruments.

12. Conductors and cables shall be run from terminal to terminal without splice or joints. Exceptions:

    a. Factory applied connectors molded onto cables shall be permitted. Such connectors shall not be considered as splices or joints.

13. The control panel shall be the source of power for all 120 VAC devices interconnected with the control panel including, but not limited to:

    a. Solenoid valves.

    b. Instruments both mounted in the control panel and remotely connected to the control panel.

G. Thermal Management:

1. Provide heating, cooling, and dehumidifying devices in order to maintain all instrumentation and control devices to within a range as specified in Section 17050.

2. Heating:

    a. Provide all panels located in areas that are not climate controlled with thermostatically controlled strip heaters; except, where all of the following conditions apply:

        1) The panel is not supplied with 120 VAC power.

        2) There are no electronics or moisture-sensitive devices in the enclosure.

        3) The panel is smaller than 38 inches high.

3. Enclosure Temperature Sensor as indicated on the Drawings:

    a. Provide wall mount RTD transmitter to measure internal cabinet temperature, in all enclosures containing electrical components such as PLCs, RTUs, RIO, and VFDs.

    b. Platinum RTD.

    c. 4-20 mA output.

    d. Sensor and electronic enclosure.

    e. Accuracy: ±2.0 degrees Fahrenheit.

    f. Manufacturer: One of the following:

        1) Omega, EWS series.

        2) TCS Basys Controls, TS Series as indicated on the Drawings:

4. Enclosure Temperature Switch:

    a. Provide wall mount bimetallic switch transmitter (to measure internal cabinet temperature in all enclosures) containing electrical components such as PLCs, RTUs, RIO, and VFDs.

    b. Sensor and electronic enclosure.

    c. Accuracy: ±2.0 degrees Fahrenheit.

    d. Manufacturer: One of the following or approved equal:

        1) Hoffman ATEMNC.

5. Fan Ventilation:

    a. Provide Hoffman fan speed control:

        1) Automatically adjust fan speed depending on remote temperature sensor input.

        2) Field adjustable temperature sensitivity.

        3) Polycarbonate control housing.

        4) 120 VAC 60 Hz.

5) NEMA Type 5-15R cord connections.

6) Mounting:

a) Panel mount:

(1) Mounting brackets.

b) Rack mount:

(1) Designed for fan cooling trays.

(2) 1 RU rack space.

b. Muffin style:

1) Provide two door/cabinet mounted vent fans for every 72 inches of cabinet width.

2) Provide Finger Guard kit.

3) Filter kit with 2 spare filters for each intake fan.

4) Provide bezel and gasket kit.

5) Provide fan shroud.

c. Temperature control switch and alarm:

1) Power: 120 VAC.

2) Bimetallic temperature senor.

3) Adjustable setpoint range 30 degrees Fahrenheit to 140 degree Fahrenheit.

4) Hoffman ATEM series or equal.

d. Fan Tray:

1) Provide rack mount fan tray with 6 fans.

2) Provide top mount fan shroud.

H. Panel Meters:

1. Human Machine Interface (HMI)

a. General:

1) A HMI shall be provided on the face of the Control Panel enclosure for monitoring and control of the system. Additional HMIs may be provided on individual units local control panels at the supplier's discretion.

2) The local SCADA system shall continuously monitor all operating parameters, and shall respond to alarms and emergency conditions by shutting down or activating system components. The SCADA system shall indicate alarm conditions locally at the HMI, and remotely Central for monitoring by the SCADA system.

3) The local SCADA system shall be integrated into the overall SCADA system via Ethernet.

4) The local SCADA system shall be capable of sending and receiving equipment status signals, analog data and alarms, and receiving both discrete and analog control signals from the PLC system via Ethernet.

5) The SCADA system (provided by the ICSC) will be configured to store data for the system for reports and alarm generation. System manufacturer shall provide information on register addresses on all data, which are to be transmitted. The data register shall be contiguous for each data type.

6) All PLC, SCADA and HMI programming required for fully functional package control system.

b. Hardware Requirements:

1) NEMA Type 4 rated.

2) HMI shall communicate directly with PLC processor via dedicated communication cable.

3) Provide color touch-screen type display.

4) Telemecanique: Magelis to match Owner Standard.

I. Pilot Devices:

1. General:

a. Provide operator pushbuttons, switches, and pilot lights, from a single manufacturer.

b. Size:

1) 30.5 mm.

c. Heavy duty.

d. Pushbuttons:

1) Contacts rated:

a) NEMA Type A600.

2) Furnish one spare normally open and normally closed contact with each switch.

e. Selector switches:

1) Contacts rated:

a) NEMA Type A600.

b) Knob type:

2) Furnish one spare normally open contact and normally closed contact with each switch.

3) Provisions for locking in the OFF position where lockout provisions are indicated on the Drawings.

f. Pilot lights:

1) Type:

a) LED for interior and exterior installations.

2) Push to Test.

3) Lamp Color:

a) On/Ready/Start: Green.

b) Off/Stop/Running: Red.

c) Power: White.

d) Alarm: Amber.

e) Status or Normal Condition: White.

f) Opened: Amber.

g) Closed: Blue.

h) Failure: Red.

2. All Areas:

a. NEMA Type 4X.

b. Corrosion resistant.

c. Exterior parts of high impact strength fiberglass reinforced polyester or multiple-layer epoxy coated zinc:

1) All contacts contained within a hermetically sealed chamber:

a) Pushbuttons.

b) Selector switches.

c) Push-to-test contacts on pilot lights.

2) UL listed and labeled for Class I Division 2 areas.

d. Manufacturer: One of the following:

1) Cutler Hammer Type E34.

2) Allen Bradley Type 800H.

J. Signal isolators and converters:

1. Furnish signal isolators that provide complete isolation of input, output, and power input:

a. Minimum isolation level: 1.5 kV AC/50 Hz for at least 1 minute.

b. Adjustable span and zero.

c. Accuracy: ±1.0 percent of span.

d. Ambient temperature range: -20 degrees Celsius to +65 degrees Celsius.

2. Manufacturer: One of the following:

a. Phoenix Contact MCR Series.

b. Acromag 1500, 600T, 800T, Flat Pack or ACR Series.

c. Action Instruments Q500 Series or Ultra SlimPakII.

d. AGM electronics Model TA-4000.

K. Relays:

1. General:

a. For all types of 120 VAC relays, provide surge protection across the coil of each relay.

b. For all types of 24 VDC relays, provide a free-wheeling diode across the coil of each relay.

2. General Purpose:

a. Magnetic control relays.

b. NEMA Type A300 rated:

1) 300 Volts.

2) 10 Amps continuous (minimum).

3) 7,200 VA make.

4) 720 VA break.

c. Plug-in type.

d. LED indication for relay energized.

e. Coil voltages: As required for the application.

f. Minimum poles: DPDT.

g. Touch safe design: All connection terminals to be protected against accidental touch.

h. Enclose each relay in a clear plastic heat and shock-resistant dust cover.

i. Quantity and type of contact shall be as shown on the Drawings or as needed for system compatibility.

j. Relays with screw-type socket terminals.

k. Provide additional (slave/interposing) relays when the following occurs:

1) The number or type of contacts shown exceeds the contact capacity of the specified relays.

2) Higher contact rating is required in order to interface with starter circuits or other equipment.

l. DIN rail mounting on 35 mm rail.

m. Ice cube type relays with retainer clips to secure relay in socket.

n. Integrated label holder for device labeling.

o. Manufacturer: One of the following:

1) Phoenix Contact PLC series.

2) Potter and Brumfield Type KRP or KUP.

3) IDEC R* series. (* = H, J, R,, U).

4) Allen Bradley Type 700 H Series.

5) Square D Type K.

3. Latching:

a. Magnetic latching control relays.

b. NEMA Type B300 rated:

1) 300 Volts.

2) 5 Amps continuous.

3) 3,600 VA make.

4) 360 VA break.

c. Plug-in type.

d. DIN rail mounting on 35 mm rail.

e. Coil voltage: as required for the application.

f. Minimum poles: 2PDT; as required for the application. Plus 1 spare pole.

g. Touch safe design: All connection terminals to be protected against accidental touch.

h. Clear cover for visual inspection.

i. Provide retainer clip to secure relay in socket.

j. Manufacturer: One of the following, or equal:

1) Square D type 8501 Type KL.

2) IDEC TWTD RH2L.

4. Time Delay:

a. Provide time delay relays to control contact transition time.

b. Contact rating:

1) 240 Volts.

2) 10 Amps continuous.

3) 3,600 VA make.

4) 360 VA break.

c. Coil voltage: as required for the application.

d. Provide Pneumatic or Electronic type with on-delay, off-delay, and on/off delay:

1) For off delay use true power off time delay relays. Where the required timing range exceeds capability of the off delay

relay use signal off delay where power loss will not cause undesirable operation or pneumatic time delay relays.

e. Minimum poles: 2PDT.

f. Units include adjustable dial with graduated scale covering the time range in each case.

g. Minimum timing range: 0.1 seconds to 10 minutes, or as required for the application.

h. Manufacturer: One of the following:

1) IDEC RTE series.

2) Agastat type Series 7000 series (pneumatic).

L. Terminal blocks:

1. Din rail mounting on 35 mm rail.

2. Suitable for specified AWG wire.

3. Rated for 30 amperes at 600 Volts.

4. Screw terminal type.

5. Provide mechanism to prevent wire connection from loosening in environments where vibration is present. This mechanism shall not cause permanent deformation to the metal body.

6. Finger safe protection for all terminals for conductors.

7. Construction: Polyamide insulation material capable of withstanding temperature extremes from - 40 degree Celsius to 105 degrees Celsius.

8. Terminals: Plainly identified to correspond with markings on the diagrams:

a. Permanent machine printed terminal identification.

9. Disconnect type field signal conductor terminals with socket/screw for testing.

10. Identify terminals suitable for use with more than 1 conductor.

11. Position:

a. So that the internal and external wiring does not cross.

b. To provide unobstructed access to the terminals and their conductors.

12. Provide minimum 25 percent spare terminals.

13. Manufacturer: One of the following:

a. Phoenix Contact UK5 Series.

b. Allen Bradley Series 1492.

14. Wire duct:

a. Provide flame retardant plastic wiring duct, slotted with dust cover.

b. Type:

1) Wide slot.

2) Narrow slot.

3) Round hole.

c. Manufacturer: One of the following:

1) Panduit.

M. Surge Protection Devices:

1. Provide Surge Protection Device (SPD) for Power Entrances:

a. Nominal 120 VAC with a nominal clamping voltage of 200 Volts.

b. Non-faulting and non-interrupting design.

c. A response time of not more than 5 nanoseconds.

2. Control Panel Power System Level Protection, non-UPS powered:

a. Design to withstand a maximum 10 kA test current of a 8/20 μs waveform according to ANSI/IEEE C62.41.1-2002 Category C Area.

b. Provide both normal mode noise protection (between current carrying conductors) and common mode (between current carrying conductor and neutral) surge protection.

c. DIN rail mounting.

d. Attach wiring to the SPD by means of a screw type cable-clamping terminal block:

1) Gas-tight connections.

2) The terminal block: Fabricated of non-ferrous, non-corrosive materials.

e. Visual status indication of MOV status on the input and output circuits.

f. Dry contact rated for at least 250 VAC, 1 Amp for remote status indication.

g. Meeting the following requirements:

1) Response time: ≤100 ns.

2) Attenuation: ≥ -40 dB at 100 kHz as determined by a standard 50 ohms insertion test.

3) Safety approvals:

a) UL 1283 (EMI/RFI Filter).

b) UL 1449 2nd Edition.

h. Manufacturer: One of the following:

1) Phoenix Contact type SFP TVSS/Filter.

2) Liebert Accuvar series.

3) Islatrol.

3. Data and Signal Line Protectors - Panel Mounted:

a. Surge protection minimum requirements: Withstand a 10 kA test current of a 8/20 µs waveform in accordance with ANSI/IEEE C62.41.1-2002 Category C Area.

b. DIN rail mounting on 35 mm rail (except field mounted SPDs).

c. SPDs consisting of 2 parts:

1) A base terminal block.

2) A plug protection module:

a) Replacing a plug does not require the removal of any wires nor interrupt the signal.

b) Base and plug coded to accept only the correct voltage plug.

d. SPD Manufacturer: One of the following:

1) Phoenix Contact Plugtrab Series.

2) Bournes Series 1800.

4. Data and Signal Line Protectors - Field Mounted:

a. Surge protection minimum requirements: Withstand a minimum 10 kA test current of a 8/20 µs waveform in accordance with ANSI/IEEE C62.41.1-2002 Category C Area.

b. Manufacturer: One of the following:

1) Phoenix Contact Pipetrab.

2) Joslyn JMD Series.

N. Power supplies:

1. Design power supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the system operation.

2. Convert 120 VAC to 24 volt DC or other DC voltages required or as required for the application.

3. Provide backup 24 VDC power supply units to automatically supply the load upon failure of the primary supply.

4. Provide power supply arrangement that is configures with several modules to supply adequate power in the event of a single module failure:

a. Provide Automatic switchover upon module failure.

b. Alarm contacts monitored by the PLC.

5. Sized to provide 40 percent excess rated capacity.

6. UL508C listed to allow full rated output without de-rating.

7. Provide fuse or short-circuit protection.

8. Provide a minimum of 1 set of dry contacts configured to change state on failure for monitoring and signaling purposes.

9. Output regulation: ±0.05 percent for a 10 percent line change or a 50 percent load change:

   a. With remote voltage sensing.

10. Operating temperature range: 0 degrees Celsius to 50 degrees Celsius.

11. Touch safe design: All connection terminals to be protected against accidental touch.

12. DIN rail mounting on 35 mm rail.

13. Provide self-protecting power supplies with a means of limiting DC current in case of short circuit.

14. Manufacturer: One of the following:

   a. Phoenix Contact Quint series 2866763 and 2320173 .

   b. IDEC PS5R series.

   c. Sola.

   d. Acopian.

O. Limit Switches:

1. NEMA-4X.

2. AC contact rating 120 V, 10 A.

3. DC contact rating 125 V, 0.4 A.

4. Provide robust actuation mechanism not prone to degradation.

5. Provide complete actuator mechanism with all required hardware.

6. Allows for contact opening even during contact weld condition.

7. UL approved.

8. Operating Temperature Range: -18 degrees to +110 degrees Celsius (0 degrees to 230 degrees Fahrenheit).

9. Manufacturer:

   a. Allen Bradley 802.

   b. Honeywell HDLS.

   c. Omron D4.

   d. Eaton E47, E49, E50.

   e. ABB equal.

2.04 ACCESSORIES

A. Refer to Section 17050.

B. Provide panels with an inside protective pocket to hold the panel Drawings. Ship panels with 1 copy of accepted Shop Drawings including, but not limited to,

schematic diagram, connection diagram, and layout drawing of control wiring and components in a sealed plastic bag stored in the panel drawing pocket.

C. Provide 15-inch floor stands or legs where needed or as indicated on the Drawings.

D. Provide a folding shelf for enclosures that contain programmable controllers. The shelf shall be mounted on the inside surface of the door, capable of supporting a laptop computer.

E. Provide nameplate to each panel as indicated on the Drawings:

1. Provide in accordance with Section 16075 on all internal and external instruments and devices.

2. Provide a nameplate with the following markings that is plainly visible after installation:

a. Manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the panel can be identified.

b. Supply voltage, phase, frequency, and full-load current.

c. Short-circuit current rating of the panel based on one of the following:

1) Short-circuit current rating of a listed and labeled assembly.

2) Short-circuit current rating established utilizing an approved method.

3. Provide enclosures with a flange mounted disconnect that is interlocked with the doors.

F. Provide a window kit where indicated on the Drawings. The window shall meet the following requirements:

1. Safety plate glass.

2. Secured by rubber locking seal.

3. Allow full viewing of devices issuing visual process data or diagnostics.

G. Lighting:

1. Provide 1 luminaire for each section, on the interior of the panel, spaced evenly along the top-front of the enclosure door opening(s):

a. Covered or guarded.

b. Provide On-Off door-activated switches where indicated on the Drawings.

c. Provide 18-watt fluorescent lamp for indoor enclosures:

1) Provide additional fixtures for every 36 inches of width.

d. Provide 40 watt incandescent lamp for exterior enclosures:

1) Provide additional fixtures for every 36 inches of width.

H. Receptacles:

1. Provide one duplex receptacle located every 4 feet of enclosure width, spaced evenly along the back mounting panels.

2. GFCI, 125-volt, single-phase, 15-amp style plug.

3. Provide circuit breaker or fuse to limit receptacle draw to 5 amp.

I. Grounding:

1. Provide the following:

a. Grounding strap between enclosure doors and the enclosure.

b. Equipment grounding conductor terminals.

c. Provide equipment ground bus with lugs for connection of all equipment grounding wires.

d. Bond multi-section panels together with an equipment grounding conductor or an equivalent grounding bus.

2. Identify equipment grounding conductor terminals with the word “GROUND,” the letters “GND” or the letter “G,” or the color green.

3. Signal (24 VDC) Grounding: Terminate each drain wire of a signal (shielded) cable to a unique grounding terminal block, or common ground bus at the end of the cable as shown on the Loop Drawings.

4. Ensure the continuity of the equipment grounding system by effective connections through conductors or structural members.

5. Design so that removing a device does not interrupt the continuity of the equipment grounding circuit.

6. Provide an equipment-grounding terminal for each incoming power circuit, near the phase conductor terminal.

7. Size ground wires in accordance with NEC and UL Standards, unless noted otherwise.

8. Connect all exposed, noncurrent-carrying conductive parts, devices, and equipment to the equipment grounding circuit.

9. Connect the door stud on the enclosures to an equipment-grounding terminal within the enclosure using an equipment-bonding jumper.

10. Bond together all control panels both remote and local, processor racks, and conductive enclosures of power supplies and connect to the equipment grounding circuit to provide a common ground reference.

2.05 FINISHES

A. Finishes:

1. Metallic (Non-Stainless):

a. Metal surfaces of panels shall be prepared by chemical cleaning and mechanical abrasion in accordance with the finish manufacturer’s recommendations to achieve a smooth, well-finished surface.

b. Scratches or blemishes shall be filled before finishing. One coat of zinc phosphate shall be applied per the manufacturer’s

recommended dry film thickness, and allowed to dry before applying the finish coat.

c. Finish coat shall be a baked polyester urethane powder, aliphatic air-dry polyurethane, or epoxy enamel to meet NEMA rating specified application.

d. Exterior of enclosures located outdoors shall be UV resistant polyester powder coating. Total dry film thickness shall be 3 mils, minimum.

2. Stainless Steel:

a. Stainless enclosures shall be provided with a Number 4 brushed finish - not painted.

B. Colors:

1. Exterior color of panels mounted indoors shall be manufacturer's standard light gray.

2. Exterior of panels mounted outdoors shall be manufacturer's standard white.

3. Panel interiors shall be manufacturer's standard white.

2.06 SOURCE QUALITY CONTROL

A. Refer to Section 17050.

2.07 HMI PROGRAMMING

A. General:

1. The HMI programming software system shall be manufactured by HMI hardware manufacturer.

2. Provide one licensed copy of HMI programming software to the OWNER.

B. HMI programming software shall be one of the following:

1. Modicon Vijeo Designer.

C. Coordination with plant control system

1. Coordinate with the ICSC and OWNER to determine the requirements for data transfer between the HMI and the plant process control system.

2. Supplier shall program HMI to aggregate the data into contiguous registers for efficient transfer to the plant process control system.

3. Minimum data transfer shall be as indicated on the P&IDs. Supplier shall supplement the I/O requirements with setpoints and virtual I/O required to implement the control strategies as specified in this Section.

D. General programming requirements:

1. Use variable names or aliases derived from tag and loop identification on the P&IDs for all process values.

2. Program slew rates for all setpoints to limit the effect of updated setpoints on the process:

a. Provide for control setpoints and manual speed and position selections.

b. Store new setpoints in one register, and gradually ramp the actual setpoint register at the slew rate until it reaches the new value.

c. Provide operator access to change slew rates through the controls system.

3. Saved setpoints:

a. Provide an operator selection to save all setpoint values.

b. Provide an operator selection to restore all setpoints to the last saved value.

4. Calculated values:

a. Program calculations such that division by zero errors cannot occur.

b. Prevent calculations from generating values that exceed the limits of the equipment or data type structures (integers) internal to the PLC.

c. Configure counting functions (start counts and operation counts) to allow a minimum of 10,000 counts and to rollover to zero at an even decimal interval (1 followed by 4 or more zeros).

5. Timers:

a. Provide programmable settling and proving timers in all control sequences for starting and stopping of equipment to allow the process to settle down before proceeding with any additional control functions.

6. PLC status:

a. Furnish all information that depicts the status of all enclosures containing PLC or I/O in the control system, including but not limited to the following:

1) PLC cabinet over-temperatures from high temperature switch.

2) Intrusion status on all enclosures equipped with intrusion switches.

3) AC power failure:

4) DC power supply failure:

5) UPS failure signal.

7. PLC system communication status:

a. Furnish a minimum of 1 screen to display all communication errors and status within the control system network:

1) Communication between SCADA and PLC,

2) PLC to RIO.

3) Digital bus network status.

4) Display status of each node, and summary of failures over the past 60 minutes.

b. Generate a communications alarm if any communication fault is detected.

c. In the event of communications loss:

1) Continue normal operation at each PLC with last known shared values.

E. Common control functions:

1. Incorporate common control functions into all control loops and devices and into the control programming, whether or not specifically specified in the specific control descriptions or elsewhere in the Contract Documents.

2. Alarms:

a. Generate alarms within the PLC logic.

b. Indicate alarms at SCADA and the HMI. Enable acknowledgement from the HMI.

c. Once the alarm is acknowledged by an operator, display alarm conditions in a steady state (not flashing) while the alarm condition is still present:

d. Use interlocks and proving timers to prevent alarms from operating due to power loss, except for loss of power alarms.

3. Where run time accumulation is required, integrate accumulated run time to the nearest 0.1 hours whenever the running status input indicates that the equipment is running:

a. Display total run time in hours.

4. For all monitored analog values:

a. Totalize flows: Display totals on the HMI.

5. Analog data processing:

a. Engineering units conversion: Use engineering units for all analog point values. Convert analog inputs to engineering units.

b. Analog magnitude checking: Provide clamps to prevent operator-entered values (setpoints, etc.) that fall outside acceptable limits.

6. Tank and vessel levels:

a. Display all tank and vessel levels as both a level (typically in feet) and a volume (typically in gallons):

1) Some individual displays may be only level or volume, when agreed to by the OWNER and ENGINEER during the submittal phase.

b. Monitor rate of change of volume on all tanks and vessel:

1) Establish the maximum rate at which the volume should decrease (all pumps or feeders operating at maximum

output). Generate an alarm whenever the volume decreases faster than this rate.

7. I/O filtering and processing:

   a. Analog input filtering:

      1) Provide RTU programming for each analog input to implement an adjustable first order filter, for the purpose of smoothing out spikes and other noise for analog transmitter input signals. By default, shall configure analog inputs with no filtering affect.

      2) Monitor analog input signal quality:

         a) Over range: The input value is above the normal range (typically over 21 mA).

         b) Under range: The input value is below the normal range (typically under 3 mA, indicating a probable broken connection).

         c) Generate alarms for over or under range inputs.

         d) Do not use over- or under-range values for control or calculation purposes:

            (1) Where a second instrument is provided to monitor the same condition (a redundant instrument, or additional instruments furnished for averaging or different operating modes), and has a valid signal, use that input for control.

            (2) Otherwise, hold all outputs affected by the signal at their last values before the signal went out of range.

      3) Digital input filtering (proving timer):

         a) Provide an adjustable time delay function (0-10 seconds) on discrete input for the purpose of de-bouncing. By default, discrete inputs shall be configured with de-bounce timers set to zero seconds.

8. HMI/OIT HAND-OFF-AUTO:

   a. Where indicated, provide HAND-OFF-AUTO and START-STOP selections accessed from an HMI or OIT for operators with sufficient security, to provide the following operating modes:

      1) AUTO: The normal, Automatic control mode of the strategy which allows full PLC control in response to process conditions and programmed sequences.

      2) HAND: Enables Manual control where control decisions are made by an operator through the START-STOP, OPEN/CLOSE, or other selections as indicated.

3) OFF: Automated control is disabled and PLC calls for all associated equipment to stop and valves to close or go to their identified safe state.

9. Display the current status of all operator selections (HAND/AUTO, START/STOP, etc.) on HMI and SCADA.

10. Motor control:

a. Display current REMOTE status on the screens.

b. Monitor the device's running status.

2.08 SCADA SOFTWARE LICENSE

A. Provide un-opened boxes containing two (2) each latest version of VTS Trihedral software 500,000 tag runtime version, and any other associated software, manuals and disks licensed to the Owner two weeks prior to the start of any SCADA field testing.

B. Provide and submit proof that software is licensed to Owner when software is delivered to Owner.

C. It is the System Supplier's responsibility to obtain all SCADA configuration & communication software, manuals, and disks necessary for the System Supplier to program and configure the SCADA SYSTEM. Owner's configuration software, manuals and disks shall not be available to the System Supplier for use.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install enclosures so that their surfaces are plumb and level within ±1/8 inch over the entire surface of the panel; anchor securely to wall and structural supports at each corner, minimum. Direct attachment to dry wall is not permitted.

B. Install the enclosure per guidelines and submitted installation instructions to meet the seismic requirements at the project site.

C. Provide floor stand kits for wall-mount enclosures larger than 48 inches high.

D. Provide 3-1/2 inch high concrete housekeeping pads for free-standing enclosures.

E. Install gasket and sealing material under panels with floor slab cutouts for conduit:

1. Undercoat floor mounted panels.

F. Provide a full size equipment-grounding conductor in accordance with NEC included with the power feeder. Terminate to the incoming power circuit-grounding terminal.

G. All holes for field conduits, etc. shall be cut in the field, there shall be no additional holes, factory cut holes, or hole closers allowed. Incorrect holes, additional holes, or miss-cut holes shall require that the entire enclosure be replaced.

H. Control panels that are adjacent to motor control centers shall be fully wired to the motor control centers using wireways integral to the motor control center or additional conduits as needed. These interconnections are not shown or reflected

on the conduit schedule, but shall be shown on the Loop Drawings prepared by the CONTRACTOR.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 17050.

3.03 CLEANING

A. As specified in Section 17050.

3.04 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

END OF SECTION

SECTION 17712

CONTROL SYSTEMS – UNINTERRUPTIBLE POWER SUPPLIES 10 KVA AND BELOW

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Single-phase double conversion uninterruptible power supplies rated 10 kilovolt-amperes and below.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

a. Items involving electrical, control, and instrumentation construction may be indicated on the Drawings or specified in the Specifications that do not apply specifically to electrical, control and instrumentation systems.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 01900 - Seismic Criteria.

c. Section 16050 - Common Work Results for Electrical.

d. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.02 REFERENCES

A. As specified in Sections 16050 and 17050.

B. American National Standards Institute (ANSI):

1. ANSI C62.41 (IEEE 587) - Guide for Surge Voltages in Low Voltage AC Power Circuits.

C. Federal Communications Commission (FCC):

1. FCC Part 15, Class A.

2. FCC Part 15, Class B.

D. Institute of Electrical and Electronic Engineers (IEEE):

1. IEEE 519 - Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.

2. IEEE 1184 - Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems.

E. International Organization for Standardization (ISO):

1. ISO 9001.

F. National Electrical Manufacturers Association (NEMA):

1. NEMA PE1 - Uninterruptible Power Systems Specification and Performance Verification.

G. Underwriters Laboratories, Inc. (UL):

1. UL 1778 - Standard for Uninterruptible Power Supply Systems and Equipment.

1.03 DEFINITIONS

A. As specified in Sections 16050 and 17050.

B. Specific definitions:

1. Critical load: Load supplied by the UPS.

2. MOV: Metal oxide varistor.

1.04 SYSTEM DESCRIPTION

A. Provide complete, factory-assembled, wired, and tested, true on-line double conversion UPS equipment including, but not limited to, rectifier, DC bus, inverter, battery charger, batteries, automatic bypass, and ancillary components as specified herein and as indicated on the Drawings.

B. UPS loads as indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 and 17050.

B. Product data:

1. Manufacturer and model number.

2. Catalog data.

3. Dimensions:

a. Height.

b. Width.

c. Depth.

d. Weight.

4. Ratings:

a. Input voltage.

b. Output voltage.

c. Input/output power factor.

d. Efficiency.

e. Harmonic distortion.

f. Runtime.

5. Noise specifications.

6. Heat dissipation.

7. Warranties and maintenance contracts:

a. Documentation to demonstrate conformance to specifications noted in this Section.

b. Descriptive package of offerings of preventative and full service maintenance contracts for both UPS system and batteries.

c. Extended warranty options available.

8. All communications requirements such as software, cards, etc.

9. Alarms and status available for remote monitoring and system health.

C. Shop drawings:

1. Power distribution block diagrams.

2. Front and rear views of equipment enclosures:

a. Front elevation including all control and indicating devices.

3. Support points and weight of overall equipment.

4. Schematic and control wiring diagrams including, but not limited to:

a. Line and load terminals.

b. Alarm and status terminals.

c. External wiring requirements for all communication signals.

5. Switching and overcurrent protective devices.

D. Calculations:

1. Include derating for temperature and elevation as necessary.

2. UPS sizing computation:

a. Apply safety factors as specified in this Section.

b. Provide itemized list of critical loads, including individual VA and watt ratings.

3. Battery time calculation based on specified runtime.

4. Total battery recharge time as a function of capacity utilized.

E. Design data:

1. Design mounting and anchorage for seismic design criteria specified in Section 01612:

a. Provide seismic kits as required to meet design criteria.

F. Record documents:

1. Provide Record Drawings of installed unit(s) including layout and wiring.

G. Manufacturer's field reports.

H. Operation and maintenance manuals:

1. System instruction manuals that describe troubleshooting, installation, operations, and safety procedures.

2. Recommendations for maintenance procedures and intervals.

3. Battery data / replacement information.

4. Parts list.

1.06 QUALITY ASSURANCE

A. Manufacturer qualifications:

1. A minimum of 10 years' experience in the design, manufacture, and testing of solid-state UPS systems.

2. ISO 9001 certified.

B. Regulatory requirements for complete UPS system:

1. UL listed per UL Standard 1778

2. IEEE C62.41, Categories A & B.

3. FCC 15:

a. Greater than 2,000 VA - Class A.

b. Less than 2,000 VA - Class B.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.09 WARRANTY

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Double-conversion true-online UPS manufacturers, to match Owner Standard:

1. Rack-mounted UPS, 700-3,000 VA:

a. 3U UPS APC SURTA3000RMXL3U

b. 2U UPS APC SURTA1500

2.02 MANUFACTURED UNITS

A. Double conversion true on-line UPS system requirements:

1. System characteristics:

a. Provide rack-mount UPS as specified and as indicated on the Drawings.

b. The minimum VA rating of the UPS shall be greater than or equal to the safety factor (as indicated in the UPS schedule) times the connected load, whichever is greater.

c. Battery runtime at full load and site ambient temperature as indicated in the UPS schedule.

d. Efficiency greater than 85 percent AC-AC, all modes.

e. Acoustical noise:

1) Less than 55 dBA at 5 feet.

f. Output connections:

1) Receptacles:

a) 700-2,500 VA units:

(1) Provide a minimum of four NEMA Type 5-20R receptacles.

b) 3,000 VA units:

(1) Provide a minimum of four NEMA Type 5-20R receptacles.

(2) Provide at least one NEMA Type L5-30R receptacle.

2) Provide connections as indicated on the Drawings.

g. Protection:

1) Undervoltage:

a) Operate on battery power if incoming source voltage goes below UPS system limits of operation.

2) Overvoltage:

a) Operate on battery power if incoming source voltage exceeds UPS system limits of operation.

3) Overcurrent:

a) Provide input and output current-limiting protection to ensure adequate overcurrent protection for UPS.

4) Surge protection:

a) MOV-based.

2. Electrical characteristics:

a. AC input:

1) Single phase.

2) Voltage as indicated in the UPS schedule.

a) Fully functional within +10 percent, -15 percent of nominal voltage at full load without depleting battery.

b) 120 V input:

(1) 2-wire plus ground.

c) 208/120 V or 240/120 input:

(1) 3-wire plus ground.

3) Current:

a) Reflected total harmonic distortion (THD) less than 25 percent at rated load.

4) Frequency range of operation:

a) 57-63 Hz.

5) Power factor:

a) Not less than 0.95 lagging at rated load.

b. AC output:

1) Single phase.

2) Voltage:

a) Regulation:

(1) ±3 percent for 3,000 VA rating and below.

(2) ±5 percent for greater than 3,000 VA rating - static load.

(3) ±10 percent for greater than 3,000 VA rating - dynamic load.

b) Total harmonic distortion (THD) when operating on incoming power:

(1) Not more than 3 percent for linear loads with a crest factor of 3:1.

(2) Not more than 5 percent for non-linear loads with a crest factor of 3:1.

c) Transient response:

(1) ±7 percent for a 20-100 percent step load.

(2) Transient recovery time to nominal voltage within 166 milliseconds.

3) Load power factor:

a) UPS shall be capable of supporting the critical loads for all power factors experienced for their full range of operation.

4) Frequency regulation:

a) Within ±3.5 Hz when on utility power.

b) Within ±1.0 Hz when on UPS power.

3. Environmental requirements:

a. Operating ambient temperature:

1) UPS module: 50 degrees Fahrenheit to 104 degrees Fahrenheit (10 degrees Celsius to 40 degrees Celsius).

2) Battery: 68 degrees Fahrenheit to 86 degrees Fahrenheit (20 degrees Celsius to 30 degrees Celsius).

b. Operating altitude:

1) Project site conditions as specified in Sections 16050 and 17050.

4. System components:

a. Surge protective devices:

1) MOV-supplied protection.

b. Inverter:

1) Pulse-width modulated AC output signal.

2) Overload withstand minimum time without transferring to bypass:

a) 101 to 110 percent for 2 minutes.

b) 111 to 125 percent for 10 seconds.

c) 126 to 150 percent for 1 second.

d) Greater than 150 percent for 96 milliseconds.

3) Transfer load to bypass when overload capacity is exceeded.

c. Battery rectifier/charger:

1) Recharge batteries to 90 percent in 6 hours or less.

d. Batteries:

1) VRLA (valve regulated lead acid), sealed, maintenance free.

2) Minimum 3-year float service life at 25 degrees Celsius.

3) Integral to UPS enclosure or housed in a matching enclosure.

4) Less than and including 6,000 VA: Hot-swappable.

5) Automatically perform routine battery health monitoring and provide visual, audible, and/or serial warnings if abnormal battery conditions exist.

6) 3000VA UPS shall be provided with two (2) each battery packs APC SURT 192RMXLLBP3U.

e. Automatic bypass switch:

1) Integral to UPS system.

2) Sense UPS overload, inverter failure, or over temperature, and automatically transfer loads to source power.

3) Maximum detect and transfer time of 4-6 milliseconds.

4) Automatic re-transfer without power interruption to critical load.

5) Input shall match output in phase, voltage, frequency, and grounding.

6) Rated to carry the full input current of the UPS.

7) Provide ability for manual operation.

f. Manual maintenance bypass switch:

1) Provides isolation of the UPS for maintenance purposes.

2) Make-before-break design so that UPS can be isolated from the critical loads by placing these loads on source power without interruption of operation.

3) Utility and UPS status indications.

4) Supply necessary input/output cords and receptacles for connections with power source and UPS.

5) Transfer time less than 6 milliseconds.

6) Rated to carry the full input current of the UPS.

7) Standalone UL-listed.

8) Input match output in phase, voltage, frequency, and grounding.

9) UPS input connection and UPS output plug:

a) 700 to 3,000 VA units: NEMA receptacle and plug to match UPS connections.

b) Above 3,000 VA units: NEMA receptacle and plug or hardwiring to match UPS connections.

10) Utility and load connections:

a) As indicated on the Drawings.

11) By manufacturer of UPS, with connections matched for operation with UPS.

g. UPS chassis:

1) Electrically isolate from AC output neutral.

2) Include an equipment ground terminal.

h. Cooling:

1) Forced air cooled.

i. Locally displayed system indicators:

1) Audible alarms during abnormal conditions:

a) UPS fault or overload condition.

b) Battery on.

c) Low battery.

d) Automatic bypass on/off.

e) Input power on.

f) Battery testing mode.

j. Controls:

1) Front-panel pushbuttons:

a) UPS start-up, shutdown, and manual bypass (for automatic bypass).

b) Testing.

c) Visual/audible alarms reset.

2) Applicable controls as specified in Communications Requirements.

k. Alarm contacts:

1) Provide relay interface card (APC Smart Slot Card AP9613) and required interposing relays for 120 VAC discrete input status signals:

a) Low battery.

b) UPS alarm.

c) On UPS power.

2) 3000VA unit shall be provided with 3 Smart Slot expansion chassis APC AP9604BLK

l. Communications requirements:

1) EtherNet/IP.

2) Network Management Card 2 with Environmental monitoring APC AP9631

B. Line-interactive UPS requirements

1. Provide rack-mount or free-standing UPS as specified and as indicated on the Drawings.

2. The minimum VA rating of the UPS shall be greater than or equal to the safety factor (as indicated in the UPS schedule) times the connected load or 700 VA, whichever is greater.

3. Battery runtime at full load and site ambient temperature as indicated in the UPS schedule.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with manufacturer's instructions.

B. Do not utilize extension cords, adapters, or other electrical connectors for UPS input.

3.02 FIELD QUALITY CONTROL

A. Perform inspections and test procedures before UPS startup:

1. Inspect equipment for signs of damage.
2. Verify installation as indicated on the Drawings and specified in the Specifications.
3. Inspect cabinets for foreign objects.
4. Verify neutral and ground conductors are properly sized and terminated.
5. Inspect battery cases.
6. Inspect batteries for proper polarity.
7. Check power and control wiring for tightness.
8. Check terminal connectors for tightness.
9. Assure connection and voltage of the battery string(s).

3.03 CLEANING

A. As specified in Section 17050.

3.04 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

3.05 SCHEDULES

END OF SECTION

SECTION 17720

CONTROL SYSTEMS – PROGRAMMABLE LOGIC CONTROLLERS HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Programmable logic controller (PLC) based control systems hardware.

B. Related Sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following Sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

c. Section 17710 - Control System - Panels, Enclosures, and Panel Components.

d. Section 17761 - Control Systems - PLC Programming Software.

1.02 REFERENCES

A. Refer to Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

B. Specific definitions:

1. CPU: Central processing unit.

C. I/O: Input/Output.

1.04 SYSTEM DESCRIPTION

A. Provide all PLC hardware as indicated on the Drawings and as specified in this Section.

1.05 SUBMITTALS

A. Provide submittals as specified in Sections 01330 and 17050.

B. Product data:

1. CPU:

a. Processor type.

b. Processor speed.

c. Memory.

d. Internal processor battery back-up time.

2. I/O modules:

a. Type.

b. Standard wiring diagram.

C. Calculations:

1. Submit calculations or documented estimate to verify that memory requirements of this Section are met, including spare requirements. If possible, use PLC manufacturer's calculation or estimating worksheet.

2. Submit calculations to verify that spare I/O requirements of this Section are met.

3. Submit calculations to verify that PLC power supply requirements of this Section are met.

1.06 QUALITY ASSURANCE

A. Provide PLC hardware manufactured at facilities certified to the quality standards of ISO 9001.

B. Additional requirements:

1. Provide PLC system components by a single manufacturer:

a. Third-party communication modules may be used only for communication or network media functions not provided by the PLC manufacturer.

2. Use PLC manufacturer approved hardware, such as cable, mounting hardware, connectors, enclosures, racks, communication cable, splitters, terminators, and taps.

3. All PLC hardware, CPUs, I/O devices, and communication devices shall be new, free from defects and produced by manufacturers regularly engaged in the manufacture of these products.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 17050.

1.09 WARRANTY

A. As specified in Section 17050.

1.10 MAINTENANCE

A. As specified in Section 17050.

B. In addition to the spare parts requirements in Section 17050, furnish:

1. 1 spare I/O cards for every type of I/O card in the system.

2. 1 spare power supplies for every power supply in the system.

3. 1 spare network and/or communications card for every network or communications card in the system.

4. 1 spare remote adaptor for every remote adaptor in the system.

C. Installed spare requirements:

1. I/O points:

a. Provide total of 25 percent spare I/O capacity for each type of I/O signal at every PLC and RIO.

b. Wire all spare I/O points to field terminal blocks in the PCM.

c. Space shall be available in each PLC or RIO enclosure to support the future addition of 100 percent additional spare I/O.

2. PLC backplane capacity:

a. 25 percent or 3 spare backplane slots, whichever is greater.

3. PLC memory:

a. 50 percent spare program volatile memory.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable manufacturers:

1. The City has standardized on the use of Modicon Quantum PLCs for the main PLCs at both water treatment plants.

2.02 MANUFACTURED UNITS

A. Programmable logic controller:

1. Construction:

a. Furnish plug-in modular system.

b. Chassis wired logic is not acceptable.

c. Provide PLCs capable of operating in a hostile industrial environment without fans, air conditioning, or electrical filtering:

1) Temperature: 0 - 55 degrees Celsius.

2) RFI: 80 - 1,000 MHz.

3) Vibration: 10 - 500 Hertz.

4) Humidity: 0 - 95 percent.

d. Provide internal power supplies designed to protect against over voltage and frequency distortion characteristics frequently encountered with the local power utility.

e. Design the PLC system to function as a stand-alone unit that performs all of the control functions described herein completely independent from the functions of the SCADA system PC-based operator interfaces:

1) Failure of the SCADA system shall not impact data acquisition, control, scaling, alarm checking, or communication functions of the PLC.

2. Components general:

a. Provide each PLC with the functionality required to implement the control strategies and database shown and specified in the Contract Documents.

b. Furnish each PLC with floating point math and PID controller modulating algorithms.

c. Provide each CPU with internal fault analysis incorporating a fail-safe mode and a dry contact output for remote location alarming, as well as a local indicator on the PLC frame in the event of a fault in the PLC.

3. Central processing unit: The PLC processor shall be Modicon Quantum model number 140-CPU-652 60.

a. Configure each central processor unit so that it contains all the software relays, timers, counters, number storage registers, shift registers, sequencers, arithmetic capability, and comparators necessary to perform the specified control functions.

b. Capable of interfacing with all discrete inputs, analog inputs, discrete outputs, and analog outputs to meet the specified requirements including the spare and expansion requirements

c. Capable of supporting and implementing closed loop floating-point math and PID control that is directly integrated into the CPU control program.

d. Design the power supply to contain capacitors to provide for orderly shutdown in the event the incoming power does not meet specifications:

1) Cease operation under this condition and force all outputs off.

4. Memory:

a. CPU program memory: 3 Mbytes.

b. Non-volatile memory: On-board complementary metal oxide semi-conductor (CMOS), electrically erasable programmable read only memory (EEPROM), PCMCIA, compact flash card, or SD card.

c. Supply with an internal lithium battery to retain non-volatile memory during power outages of up to 30 days.

1) Battery to retain charge for minimum 1 year during normal operations.

2) Furnish with an indicator showing the status of the batteries on the OIS graphic screen to alarm the operator that the batteries should be changed.

d. Supply with sufficient memory to implement the specified control functions plus a reserve capacity as specified with the requirements of this Section:

1) This reserve capacity:

a) Totally free from any system use.

2) Programmed in a multi-mode configuration with multiple series or parallel contacts, counters, timers, and arithmetic functions.

5. Programming:

a. Provide a system where processors are programmed by:

1) Portable laptop computer both locally and via the PLC data network.

2) SCADA engineer's console via the PLC data network.

6. PLC power supply: PLC power supply model number shall be Modicon Part No. 140 CPS 124 00:

a. Input: 120 VAC.

b. Output current: 8 Amps.

c. Provide each PLC power supply sized to meet the following requirements:

1) 120 VAC RMS plus or minus 15 percent, continuously.

2) 120 VAC RMS plus or minus 30 percent, maximum 30 seconds.

3) 120 VAC RMS plus or minus 100 percent, maximum 17 milliseconds.

4) Line spikes at 1,000 VAC:

a) 5,000 microsecond’s duration.

b) 0.05 percent maximum duty cycle.

c) Mounted in the PLC housing.

d) Sized to power all modules mounted in that housing including an average module load for any empty housing slots plus 50 percent above that total.

7. PLC input/output, I/O modules:

a. General:

1) Compatible with all of the PLCs being furnished under the contract and by the same manufacturer as the PLCs.

2) Provide I/O modules that:

a) Isolated in accordance with IEEE Surge Withstand Standards and NEMA Noise Immunity Standards.

b) Provide A/D and D/A converters with optically or galvanically isolated inputs and outputs.

c) Accept dual ended inputs.

3) The commoning of grounds between I/O points is not acceptable.

4) Modules that are removable without having to disconnect wiring from the module's terminals:

a) Utilize a swing-arm or plug-in wiring connector.

5) Provide at each PLC location the I/O modules required to provide the I/O points, including designated future I/O points, contained in the I/O Lists and/or shown on the P&IDs, control schematics, or described in the control strategies:

a) Provide at each PLC location an installed spare capacity in accordance with the requirements of this Section.

b) Wire all spares provided to the field terminal strip.

6) Condition, filter, and check input signals for instrument limit conditions.

7) Filter, scale, and linearize the raw signal into an engineering units based measurement.

8) Alarm measurements for high, low, rate-of-change limits, and alarm trends.

9) Provide external fuses mounted on the field connection terminal block for all discrete input, discrete output, and analog input I/O points.

10) When multiple cards of the same I/O type are provided and parallel equipment, instrumentation, or redundant processes exist, distribute I/O among cards to ensure that a single card failure will not render an entire process unavailable.

b. Discrete input modules: Discrete input modules shall be Modicon Part No. 140 DDI 853 00

1) Defined as contact closure inputs from devices external to the input module.

2) Provide inputs that are optically isolated from low energy common mode transients to 1,500 volts peak from users wiring or other I/O modules.

3) Individually isolated inputs.

4) With LED's to indicate status of each discrete input.

5) Input signal level: 24VDC

6) Provide input module points that are individually fused with blown fuse indicator lights, mounted external of the module on the output terminal strip:

a) Coordinate external fuse size with the protection located on the module, so that the external fuse opens first under a fault condition.

c. Discrete output modules: Discrete output modules shall be Modicon Part No. 140 DVO 853 00

1) Defined as contact closure outputs for ON/OFF operation of devices external to the output module

2) Optically isolated from inductively generated, normal mode and low energy, common mode transients to 1,500 volts peak.

3) LEDs to indicate status of each output point.

4) Each output point: Individually isolated.

d. Analog input modules: Analog input module shall be Modicon Part No. 140 AVI 030 00.

1) Signal type: 4 to 20 mA DC

2) Analog to digital conversion: Minimum 12-bit precision with the digital result entered into the processor.

3) The analog to digital conversion updated with each scan of the processor.Individually isolated each input.Provide individually fused analog input module points with blown fuse indicator lights, mounted external of the module on the output terminal strip:

a) Coordinate the size of the external fuse with the protection located on the module, so that the external fuse opens first under a fault condition.

e. Analog output modules: Analog output module shall be Modicon Part No. 140 ACO 130 00.

1) Signal type: 4 to 20 mA DC

2) Individual isolated output points each rated for loads of up to 1,200 ohms.

f. Pre-wired I/O cable system:

1) Provide the pre-wired I/O cables to eliminate field wiring between the I/O module and field wiring terminal blocks.

2) The pre-wired I/O cable system consists of the following:

a) Interface module terminal block assembly:

(1) Installed on standard DIN rail.

(2) Provided with terminals for necessary field wiring for 1 I/O module.

(3) Equipped with a manufacturer standard connector port.

b) Pre-wired I/O cable:

(1) 1 end terminated with manufacturer standard connector to connect to the interface module.

(2) 1 end pre-wired to a removable terminal block that plugs into the front of the I/O module.

3) Quantum screw terminal block 140XTS00206 or 140XTS01206.

4) CableFast cabling block 140CFA04000 per each DO & AO module, 140CFC03200 for each DI module, and 140CFH00800 per each AI module.

g. Network communications modules:

1) General:

a) Install communications modules in the PLC backplane

2) Ethernet: Provide network communication modules Part No. 140 NOE 77101, Ethernet Modbus/TCP Network Module and 140 NOC 77100 Ethernet/IP and Modbus TCP messaging.

a) Ports: 2.

b) Communication rate: 100 Mbit/s.

3) Modbus Plus:

a) Ports: 2.

4) Provide all network taps, connectors, termination resistors, drop cables, and trunk cables necessary for remote I/O communications.

5) Ethernet Head & Drop Adaptors 140CRP31200 and 140CRA31200.

6) Ethernet Interlak cable TCS ECN3M3M14S4 between 170NOE77101 and CRP31200

7) 2.4M Modbus Plus Tap – model number 990NAD21110.

8. PLC Housing:

a. Mount the PLC power supply, CPU, rack, and I/O modules in a suitable standard PLC rack-mounted backplane.

b. Provide spare slots in each PLC location in accordance with the requirements of this Section.

c. Provide blank slot filler module for each spare slot.

d. Install 10 slot racks No. 140 XBP 010 00 on a 140 XCP 40100 19" support for flush mounting, 125mm deep.

e. Provide empty modules 140 XCP 500 00 for all spare slots.

B. Programming:

1. As specified in Section 17761.

2.03 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Utilize personnel to accomplish, or supervise the physical installation of all elements, components, accessories, or assemblies:

1. Employ installers who are skilled and experienced in the installation and connection of all elements, components, accessories, and assemblies.

C. All components of the control system including all data network cables are the installation responsibility of the ICSC unless specifically noted otherwise.

3.02 FIELD QUALITY CONTROL

A. Refer to Section 17050.

3.03 CLEANING

A. As specified in Section 17050.

3.04 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

END OF SECTION

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SECTION 17733

CONTROL SYSTEMS – NETWORK MATERIALS AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes requirements for:

1. Materials and equipment used in process control and LAN networks including:

a. Network Hubs.
b. Network switches.
c. Media converters.
d. Routers.
e. Patch panels and other data network hardware.
f. I/O Servers
g. Domain controller
h. Related accessories.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.
b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
c. Section 17950 - Testing, Calibration, and Commissioning.

1.02 REFERENCES

A. Refer to Section 17050.

B. TIA/EIA Standards:

1. TIA/EIA-568-B (Series), Commercial Building Telecommunications Standards.

2. TIA/EIA-569 (Series), "Commercial Building Standard for Telecommunications Pathways and Spaces.

3. IEEE Series 802 standards.

1.03 DEFINITIONS

A. Refer to Section 17050.

1.04 SYSTEM DESCRIPTION

A. Provide all network equipment identified in the Contract Documents.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 and 17050.

B. Product Data:

1. Include information on all test equipment.

2. Manufacturer's operation and installation instructions.

C. Shop Drawings:

1. Complete set of drawings including but not limited to:

a. System block diagram showing relationship and connections between devices provided under this Contract. Include manufacturer and model information, and address settings.
b. Network riser diagram.
c. Network port diagram, which physically locates all, ports within the facility, and identifies their patch panel and switch port.
d. Construction drawings for all equipment cabinets, including dimensions, identification of all components, preparation and finish data, nameplates
e. Electrical connection diagrams.
f. Complete grounding requirements.

2. Furnish Data sheets for each component together with a technical product brochure or bulletin:

a. Manufacturer's model number.
b. Project equipment tag.

3. Complete and detailed bills of materials broken up by each cabinet. Each bill of material item will include the following:

a. Quantity.
b. Description.
c. Manufacturer.
d. Part numbers.

D. Test Reports:

1. As described in Section 17950 and noted herein.

2. Signed test results as described in Part 3 of this Section.

3. Test results shall include:

a. Narrative describing the test procedures followed.
b. Block diagram of test set up.
c. Manufacturer's information on test equipment used.
d. Detailed test results.

e. A narrative summarizing the results of the testing and identifying any further action required.

E. Operating Manuals:

1. Complete installation, operation, calibration, and testing manuals as described in Section 17050.

F. Record Drawings:

1. As described in Section 17050.

G. Electrical connection diagrams shall be revised to reflect any changes made in the field and submitted as record drawings.

1.06 QUALITY ASSURANCE

A. Refer to Section 17050.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Refer to Section 17050.

1.08 PROJECT OR SITE CONDITIONS

A. Refer to Section 17050.

1.09 WARRANTY

A. Refer to Section 17050.

PART 2 - PRODUCTS

2.01 MANUFACTURERED UNITS

A. Ethernet switches:

1. Process Floor Ethernet Switches:

a. Manufacturers - One of the following:

1) NTRON 7018FX2 Series.

2) NTRON 7506GX2.

3) No Equal.

b. Properties:

1) Hardware:

a) Power supply:

(1) Provide redundant power supplies.

(2) 24 VDC, 350 Watts/per power supply.

2) Performance:

a) Switch fabric speed: 8 Gbps, minimum.

3) Environment:

a) Operating Temperature Range: 32 to 131 Degrees Fahrenheit.

b) Humidity: 15 to 95 percent, non-condensing.

4) Capable of performing basic switching without special programming or configurations. Additional features available through software setup includes but not limited to:

a) Remote switch management.

b) Port Security.

c) Rapid Spanning Tree protocol.

5) Connector type:

a) Fiber: SC.

b) Copper: RJ-45.

c) Provide modules required to provide network connections as indicated on the Drawings:

(1) As required to provide the number of connections required plus 20 percent spare ports of each type used.

6) Mounting:

a) Provide hardware for 19-inch rack mounting hardware.

b) As indicated on the Drawings.

2. Network Ethernet Switches:

a. Provide one of the following Network switches to match Owner Standard:

1) Dell Networking N3024F, L3, 24x1GbE SFP, 2xCombo, 2x 10GbE SFP+ fixed ports, Stacking, IO to PSU air, 1x AC PSU (210-ABOE)

2) Dell Hardware Limited Warranty Initial Year (966-3309)

3) Dell Hardware Limited Warranty Extended Year(s) (966-3311)

4) Lifetime Limited Hardware Warranty with Basic Hardware Service Next Business Day Parts Only on Your Network Switch (966-3319)

5) ProSupport: Next Business Day Onsite Service After Problem Diagnosis, Initial Year (966-3325)

6) ProSupport: Next Business Day Onsite Service After Problem Diagnosis, 2 Year Extended (966-3330)

7) ProSupport: 7x24 HW / SW Tech Support and Assistance, 3 Year (966-3378)

8) Dell ProSupport.

9) Dell Networking N2000/3000 Series User Guide (343-BBBQ)

10) Power Supply, 200w, Hot Swap, with V-Lock, adds redundancy to non-POE N3000 series switches (450-ABKG)

11) Power Cord, 125V, 15A, 10 Feet, NEMA 5-15/C13 (450-AAFH)

12) Stacking Cable, for Dell Networking N2000 or N3000 series switches (no cross-series stacking), 0.25m (470-AAPS)

b. Provide one of the following Network switches to match Owner Standard:

1) Dell Networking N3048P, L3, POE+, 48x 1GbE, 2xCombo, 2x 10GbE SFP+ fixed ports, Stacking, IO to PSU air, 1x 1100w AC PSU (210-ABOH)

2) Dell Hardware Limited Warranty Initial Year (966-3310)

3) Dell Hardware Limited Warranty Extended Year(s) (966-3312)

4) Lifetime Limited Hardware Warranty with Basic Hardware Service Next Business Day Parts Only on Your Network Switch (966-3320)

5) ProSupport: Next Business Day Onsite Service After Problem Diagnosis, Initial Year (966-3326)

6) ProSupport: Next Business Day Onsite Service After Problem Diagnosis, 2 Year Extended (966-3331)

7) ProSupport: 7x24 HW / SW Tech Support and Assistance, 3 Year (966-3379)

8) Dell Networking N2000/3000 Series User Guide (343-BBBQ)

9) Power Supply, 1100w, Hot Swap, Required for more than 900 watts of POE+, or for redundancy (450-ABKF)

10) Power Cord, 125V, 13A, 6 Feet, C15 to NEMA 5-15P (450-ADYH)

11) Stacking Cable, for Dell Networking N2000 or N3000 series switches (no cross-series stacking), 0.25m (470-AAPS)

c. Provide six (6) each Transceivers to match Owner Standard:

1) Dell Networking, Transceiver, SFP+, 10GbE, SR, 850nm Wavelength, 300m Reach - Kit (407-BBOU)

B. Media converters:

1. Copper To Fiber Transceiver:

a. Manufacturers - One of the following:

1) NTRON

2) No equal.

b. Transceiver shall be used to convert from Half/Full Duplex Ethernet to multimode fiber Ethernet 100BASE-FX:

1) Meets requirements of IEEE 802.3 Ethernet standard.

2) Supports Half/Full Duplex.

3) Connector type:

a) Fiber: SC.

b) Copper: RJ-45.

4) Power Supply:

a) 110 VAC, 60 Hz.

b) 24 VDC, 6 watts.

5) Mounting:

a) Provide mounting hardware.

b) DIN rail mounting, unless otherwise as indicated on the Drawings.

2. Modular Media Converter Systems:

a. Manufacturers - One of the following:

1) Transition Networks.

2) Or equal.

b. Use for the installation of multiple media converters into a standard 19-inch EIA rack.

c. Provide 8 slot chassis for the installation of media conversion modules.

d. Provide power supply to support media converter modules from 120 VAC power supply.

e. Provide mounting hardware for installation into standard electronic equipment rack.

f. Chassis height: 2U Rack Units.

g. Media Converter Module:

1) Port 1:

a) 100-Base-FX.

b) SC for Multimode Fiber.

2) Port 2:

a) 10/100-Base-TX.

b) RJ-45.

3) Power:

a) From main chassis.

4) Diagnostics:

a) Power Indicating LED.

b) Port Activity Indicating LED.

C. Patch panels:

1. All optical fibers shall be provided with strain relief and terminated at a fiber patch panel. All patch panel terminations shall be SC type. Final connections between the patch panel and the fiber optic network equipment shall be made via fiber optic patch cords.

2. All fibers, active and dark, shall be terminated at the patch panels.

3. Interconnect and patch panel housings shall provide space for excess fiber and provide strain relief for the fiber cable.

4. Fiber cables shall be installed such that the outer sheath of the cable is carried into the interconnect enclosure or patch panels before breaking out buffer tubes.

5. Category 6 Patch Panels:

    a. Manufacturers - One of the following:
        1) Hubbell Nextspeed.
        2) Siemon HD.
        3) Lucent Systemax.
        4) Approved equal.

    b. Patch Panels and Connectors shall meet the following (minimum) requirements:
        1) Category 6, T569A/B.
        2) RJ-45 patch cord termination: S110 UTP-STP cable termination.
        3) Capacity: 48 ports (minimum).
        4) Mounting: 19-inch rack mount.
        5) Accessories: Rear cable management bracket, individual port labels.

    c. Provide 600V rated patch cables as required to support all network devices. Provide four spare straight through 600V rated patch cables. Provide one spare cross over cable.

    d. Rack Mounted Fiber Patch Panel:
        1) Application: Use for the termination of one or more fiber cables terminating on open EIA racks and in enclosures with EIA racks.
        2) Fiber patch panels shall be provided as complete units including the housing, the connector panels, mounting hardware and the fiber connectors.
        3) Patch panels shall be provided with hardware for standard 19-inch or 23-inch rack mounting, as required.
        4) Capacity: As shown in the Contract Documents.
        5) Manufacturers:
            a) Corning Cable Systems, Connector Module Housing.

b) Or equal.

D. Network racks:

1. Provide and install all hardware and software as specified herein and as shown on the Contract Drawings. The plans and specifications describe the function and operation of the system, but do not describe all necessary devices and required modules. Provide all components required for a complete, operable and reliable system.

2. Provide the following minimum network equipment components to match Owner Standard:

a. Equipment Rack: Dell Netshelter SX 42U (A7545497) with casters, front door, cable access roof, rear cable channels, and lockable side panels. (dimensions 23.6” W x 42.1” D x 78.3” H)

1) Side Air Distribution APC ACF201BLK

2) Vertical Metered Rack Power Distribution Units (PDUs) for distributing AC power to equipment and plug strips, 120VAC, 16A, 24-NEMA 5-20R receptacles & 6-NEMA L6-20R receptacles; four (4) per rack. APC AP8863 (in place of old City standard AP7893)

3) Cable Containment bracket for vertical PDU – four (4) each APC AR7710

b. Horizontal Metered Rack PDU 120VAC, 16A, 8 each NEMA 5-15R

c. Rack stabilization plate APC AR7700 (Dell # A7239791)

d. Rack bolt down kit APC AR7701 (Dell # A7024123)

e. 5’ Power Cords C14 to C13 APC AC2-5 (Dell A3827764) Provide quantity as required.

f. Fixed shelf for radio modem. APC AR8122BLK

g. Sliding Tray – APC AR8128BLK

h. Vertical cable management ducts on both sizes of rack – four each APC AR8442

i. Rack mount horizontal 1U cable management panels – four each APC AR8612

j. Rack Mounted 120VAC, 3000VA, 3U UPS APC SURTA3000RMXL3U

1) With two (2) each battery packs APC SURT192RMXLBP3U.

2) Network Management Card 2 with Environmental monitoring APC AP9631.

3) Dry Contact SmartSlot Card AP9613

4) UPS 3-slot expansion chassis – APC AP9604BLK

k. Two (2) each 1500W POE power supplies for Chassis Switch HP J9306A to match City Standard, mounted to rear of chassis.

l. Two (2) each 24 port POE modules HP J9534A to match City Standard

m. Rack accessories:

n. Fan tray with three exhaust fans

o. Provide panels to fill all gaps as required

p. Install I/O Servers, domain controller, KVM and network switches, as specified herein, in the rack.

E. I/O Server:

1. Manufacturer – Dell with the following requirements to match Owner Standard. Two (2) each:

a. Dell hardware Limited Warranty Plus On site Service (997-2924)
b. ProSupport Plus: 7x24 Next Business Day Onsite Service, 5 year (997-2985)
c. ProSupport Plus: 7x24 HW/SW Tech Support and Assistance, 5 year (997-2994)
d. Riser with Two x16 PCIe Gen3 LP slots (x16 PCIe lanes), R430 (330-BBEF)
e. Riser with Two x16 PCIe Gen3 LP slots (x16 PCIe lanes), R430 (330-BBEF)
f. On-Board LOM 1GBE (Dual Port for Towers, Quad Port for Racks) (542-BBCO)
g. Intel Ethernet I350 QP 1Gb Server Adapter, Low Profile (540-BBHX)
h. iDRAC Port Card (330-BBDX)
i. iDRAC8 Enterprise, integrated Dell Remote Access Controller, Enterprise (385-BBHO)
j. OpenManage Essentials, Server Configuration Management (634-BBWU)
k. 2.5" Chassis with up to 8 Hot Plug Hard Drives (321-BBNK)
l. Bezel 8 Drive Chassis (325-BBII)
m. Performance BIOS Settings (384-BBBL)
n. UEFI BIOS (800-BBDM)
o. RAID 10 for H330/H730/H730P (4-8 HDDs or SSDs in pairs) (780-BBPP)
p. PERC H730P Integrated RAID Controller, 2GB Cache (405-AAEH)
q. Intel Xeon E5-2640 v3 2.6GHz,20M Cache,8.00GT/s QPI,Turbo,HT,8C/16T (90W) Max Mem 1866MHz (338-BFFO)
r. Upgrade to Two Intel Xeon E5-2640 v3 2.6GHz,20M Cache,8.00GT/s QPI,Turbo,HT,8C/16T (90W) (374-BBGV)
s. 32 GB Total each server RDIMM, 2133MT/s, Single Rank, x8 Data Width (370-ABUI)
t. 2133MT/s RDIMMs (370-ABUF)
u. Performance Optimized (370-AAIP)
v. 4 each server 600GB 10K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive,13G (400-AEER)
w. Electronic System Documentation and OpenManage DVD Kit for R430 (343-BBDT)
x. DVD+/-RW SATA Internal for 8HD Chassis (429-AAQL)
y. ReadyRails Sliding Rails With Cable Management Arm (770-BBBL)
z. Dual, Hot-plug, Redundant Power Supply (1+1), 550W (450-AEGZ)
aa. C13 to C14, PDU Style, 12 AMP, 6.5 Feet (2m) Power Cord, North America (492-BBDI)
bb. Windows Server 2012R2 Standard Edition,Factory Installed, No Media, 2 Socket, 2 VMs,NO CALs (618-BBDS)

cc. Windows Server 2012R2 Standard, Media, FI Enterprise Ed Downgrade image, Eng (634-BBPB)
dd. DIMM Blanks for System with 2 Processors (370-ABXP)
ee. Cooling Fan (370-ABXV)
ff. 135W Heatsink for PowerEdge R430 (374-BBIJ)
gg. 135W Heatsink for PowerEdge R430 (374-BBIJ)

F. Domain Server :

1. Manufacturer – Dell R430 PowerEdge with the following requirements to match Owner Standard.:

a. PowerEdge R430 Server (210-ADLO)
b. PowerEdge R430/R530 Motherboard (329-BCBR)
c. Dell Hardware Limited Warranty Plus On Site Service (997-2924)
d. ProSupport Plus: 7x24 Next Business Day Onsite Service, 5 Year (997-2985)
e. ProSupport Plus: 7x24 HW/SW Tech Support and Assistance, 5 Year (997-2994)
f. Riser with Two x16 PCIe Gen3 LP slots (x16 PCIe lanes), R430 (330-BBEF)
g. On-Board LOM 1GBE (Dual Port for Towers, Quad Port for Racks) (542-BBCO)
h. iDRAC Port Card (330-BBDX)
i. iDRAC8 Enterprise, integrated Dell Remote Access Controller, Enterprise (385-BBHO)
j. OpenManage Essentials, Server Configuration Management (634-BBWU)
k. 2.5" Chassis with up to 8 Hot Plug Hard Drives (321-BBNK)
l. Bezel 8 Drive Chassis (325-BBII)
m. Performance BIOS Settings (384-BBBL)
n. UEFI BIOS (800-BBDM)
o. RAID 10 for H330/H730/H730P (4-8 HDDs or SSDs in pairs) (780-BBPP)
p. PERC H730 Integrated RAID Controller, 1GB Cache (405-AAEG)
q. Intel Xeon E5-2640 v3 2.6GHz,20M Cache,8.00GT/s QPI,Turbo,HT,8C/16T (90W) Max Mem 1866MHz (338-BFFO)
r. Upgrade to Two Intel Xeon E5-2640 v3 2.6GHz,20M Cache,8.00GT/s QPI,Turbo,HT,8C/16T (90W) (374-BBGV)
s. 16 GB Total RDIMM, 2133MT/s, Single Rank, x8 Data Width (370-ABUI)
t. 2133MT/s RDIMMs (370-ABUF)
u. Performance Optimized (370-AAIP)
v. 4 each 300GB 15K RPM SAS 6Gbps 2.5in Hot-plug Hard Drive,13G (400-AEEH)
w. Electronic System Documentation and OpenManage DVD Kit for R430 (343-BBDT)
x. DVD+/-RW SATA Internal for 8HD Chassis (429-AAQL)
y. ReadyRails Sliding Rails With Cable Management Arm (770-BBBL)
z. Dual, Hot-plug, Redundant Power Supply (1+1), 550W (450-AEGZ)
aa. C13 to C14, PDU Style, 12 AMP, 6.5 Feet (2m) Power Cord, North America (492-BBDI)

bb. Windows Server 2012R2 Standard Edition,Factory Installed, No Media, 2 Socket, 2 VMs,NO CALs (618-BBDS)
cc. Windows Server 2012R2 Standard, Media, FI Enterprise Ed Downgrade image, Eng (634-BBPB)
dd. DIMM Blanks for System with 2 Processors (370-ABXP)
ee. Cooling Fan (370-ABXV)
ff. 135W Heatsink for PowerEdge R430 (374-BBIJ)
gg. 135W Heatsink for PowerEdge R430 (374-BBIJ)

G. Kernel Based Virtual Machine (KVM):

1. Manufacturer – Dell with the following requirements to match Owner Standard.:

a. Dell 16 port KVM switch DMPU2016 - 16 Port Keyboard/Video/Mouse Digital Switch (A7546774)
b. One 1U rackmount LED KMM console with Touchpad, English Keyboard, Widescreen 18.5" LED, ReadyRails, and 1U KVM mounting kit (A7546778)
c. One Dell Hardware One Year Warranty, Initial Year (925-2717)
d. Dell Hardware Limited Warranty Extended Two Year(s) Warranty (931-7258)
e. Basic Hardware Services: Business Hours (5X10) Next Business Day Parts Delivery Initial Year (935-4080)
f. USB Server Interface Pod, include 5 CAT cables, TAA (430-4339)
g. Video/USB Extender for KVM (A7547276)

2.02 ACCESSORIES

A. Provide duplex patch cords to connect the interface cards provided with the associated patch panels.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Refer to Section 17050.

B. All racks shall be level and plumb.

C. Install Velcro wrap on all cable bundles within the network rack/enclosure.

D. All cables and equipment shall be installed in strict conformance with the manufacturer's recommendations:

1. Cables shall be installed avoiding sharp bends.

2. Install cable using lubricant designed for cable pulling.

3. Cable ties or other cable supports shall be installed without crimping the LAN cables.

4. Install LAN cables without splices.

5. Installed bend radii shall not exceed 4 times the cable diameter.

6. Terminated all pairs at the jack and the patch panel.

E. Install cables a minimum of 40 inches away from electrical motors and transformers.

F. Install cables a minimum of 12 inches away from fluorescent lighting.

G. Individual pairs will be untwisted less than 1/2 inch at termination points.

H. All cables and terminations shall be labeled with cable designations as described in the Division 16 specifications.

I. Each data port shall be individually labeled with its patch panel/switch port ID:

1. Labeling shall be printed - no handwritten labels will be allowed.

J. At the completion of the wiring installation, provide the following documentation:

1. A plan-view of the premise(s) showing the jack numbering scheme.

2. A printed certification report for the entire wiring installation showing compliance with all ANSI/EIA/TIA specifications for data cable.

3. Reports such as those generated by Fluke DSP cable certification equipment meet this requirement.

4. Each device with a unique IP address shall be individually labeled with its IP address. The labeling shall be printed; handwritten labels will not be allowed.

K. Network patch panels and racks shall be grounded to the facility ground grid. Ethernet cables from motor starters shall be connected to grounded patch panels.

3.02 CLEANING

A. Refer to Section 17050.

3.03 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. After completion of the cable system tests and before placing the system in operation, power up all devices installed on the LAN and verify communication between the devices.

C. Verify that all equipment is operable on the network simultaneously. Confirm that all network device communications settings are properly configured.

END OF SECTION

SECTION 17761

CONTROL SYSTEMS – PLC PROGRAMMING SOFTWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Development software to be used with the specified PLC hardware.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01330 - Submittal Procedures.

b. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

c. Section 17720 - Control Systems - Programmable Logic Controllers Hardware.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

B. Specific definitions:

1. Development operating software: The software provided by the PLC manufacturer for use in programming the PLC.

2. Application software: The software that is programmed specifically for the Project.

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 and 17050.

B. Delivery criteria as specified in Section 17050.

C. Product data:

1. Programming languages.

2. Operating system requirements.

D. Control logic:

1. Fully annotated copy of programmed PLC logic.

2. Cross-referenced index of all PLC registers or points.

E. Provide application software for the specific Project process requirements.

1. Fully annotated copy of programmed PLC logic in its native format.

2. Cross-referenced index of all PLC registers or points.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050.

1.06 WARRANTY

A. As specified in Section 17050.

1.07 MAINTENANCE

A. As specified in Section 17050.

B. Provide extended 3-year manufacturer's warranty support as follows:

1. Dedicated technical support department or handled by programming staff or distributor.

2. Telephone hours for support shall be 24 hours, 7 days per week.

3. Email and web support addresses.

4. Document download via website.

5. Field service.

C. Provide system upgrades and maintenance fixes for a period of 3 years from Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The PLC programming software system shall be manufactured by PLC hardware manufacturer.

B. The following:

1. Modicon Unity Pro XL latest version.

2.02 MANUFACTURED UNITS

A. PLC programming software:

1. Furnish operating software capable of monitoring and/or control of the PLCs via the PLC data network:

a. Contain diagnostics to collect troubleshooting and performance data and display it in easy to understand graphs and tables.

b. Monitor devices at each drop on the PLC data network for proper communications.

c. Provide the ability to program all PLCs on the PLC data network from the engineer's console.

2. Operating system:

a. Microsoft Windows 7.

3. The PLC programming software shall be suitable for the PLCs specified under Section 17720.

4. PLC programming software for all programming, monitoring, searching, and editing:

a. Usable both on-line, while connected to the PLC, and off-line.

b. The operating software shall display multiple series and parallel contacts, coils, timers, counters, and mathematical function blocks.

c. Capable of disabling/forcing all inputs, outputs, and coils to simulate the elements of the ladder logic, forced elements shall be identifiable by means of color change.

d. Include a search capability to locate any address or element and its program location.

e. Display at the EC, PLC status information, such as faults and communication errors and amount of memory remaining.

5. The PLC programming software shall support the following programming languages:

a. Ladder Diagram.

6. Generate a PLC program printout, which is fully documented, through the PLC programming software:

a. Fully documented program listings include, as a minimum, appropriate rungs, address, and coils shown with comments to clarify to a reader what that segment of the program accomplishes on an individual line by line basis.

b. Include a sufficient embedded comment for every rung of the program explaining the control function accomplished in said rung.

c. Use a mnemonic associated with each contact, coil, etc., that describes its function.

d. Utilize the tag and loop identification as contained in the P&IDs:

1) If additional internal coils, timers, etc. are used for a loop they shall contain the loop number.

e. Provide a cross-reference report of program addresses.

7. Software functions automatically without operator intervention, except as required to establish file names and similar information:

a. Furnish the operating system software that is the standard uncorrupted product of the PLC manufacturer with the following minimum functions:

1) Respond to demands from a program request.

2) Dynamic allocation of the resources available in the PLC. These resources include main memory usage, computation time, peripheral usage, and I/O channel usage.

3) Allotment of system resources based on task priority levels such that a logical allocation of resources and suitable response times are assured.

4) Queuing of requests in order of priority if one or more requested resources are unavailable.

5) Resolution of contending requests for the same resource in accordance with priority.

6) Service requests for execution of one program by another.

7) Transfer data between programs as requested.

8) Management of all information transfers to and from peripheral devices.

9) Control and recovery from all program fault conditions.

10) Diagnose and report real-time hardware device errors.

8. Program execution:

a. Application software - program execution scheduled on a priority basis:

1) A multilevel priority interrupt structure is required.

2) Enter into a list of pending programs a program interrupted by a higher priority program:

a) Resume its execution once it becomes the currently highest priority program.

3) Schedule periodic programs.

4) Base the allocation of resources to a time-scheduled program on its relative priority and the availability of resources.

9. Start-up and restart:

a. Provide software that initializes and brings a PLC or any microprocessor based hardware unit from an inactive condition to a state of operational readiness.

b. Initialization:

1) Determination of system status before start-up of initializing operating system software and initializing application software.

2) Loading of all memory resident software, initializing timers, counters, and queues, and initialization of all dynamic database values.

10. Shutdown:

    a. Where possible provide orderly shutdown capability for shutdowns resulting from equipment failure, including other PLC processor failures, primary power failure, or a manually entered shutdown command.

    b. Upon loss of primary power, a high-priority hardware interrupt initiates software for an immediate, orderly shutdown.

    c. Hardware is quickly and automatically commanded to a secure state in response to shutdown command or malfunction.

    d. Alarm PLC failure at the operator interface level.

11. Diagnostics:

    a. Furnish diagnostic programs with the PLC software package to detect and isolate hardware problems and assist maintenance personnel in discovering the causes for system failures.

    b. Use the manufacturer's standard diagnostic routines as much as possible.

    c. Furnish diagnostic software and test programs for each significant component in the control system.

    d. As a minimum, provide diagnostic routines to test for power supply, central processing unit, memory, communications, and I/O bus failures.

12. Calendar/time program:

    a. The calendar/time program to update the second, minute, hour, day, month, and year and transfer accurate time and date information to all system level and application software.

    b. Variations in the number of days in each month and in leap years must be handled automatically by the program.

    c. The operator must be able to set or correct the time and date from any operator interface, only at the highest security level.

13. Algorithms:

    a. Implementation of algorithms for the determinations of control actions and special calculations involving analog and discrete data.

    b. Algorithms must be capable of outputting positional or incremental control outputs or providing the product of calculations.

    c. Algorithms must include alarm checks where appropriate.

    d. Provide, as a minimum, the following types of algorithms:

1) Performs functions such as summing several variables, raising to a power, roots, dividing, multiplying, and subtracting.

2) A switch algorithm, which reads the current, value from its input address and stores it as the value of its output address. 2 types of switches shall be accommodated, 2 outputs with 1 input and 1 output with 2 inputs.

3) A 3-mode proportional - integral - derivative, PID, controller algorithm, with each of the 3 modes independently adjustable, supporting both direct and reverse acting modes.

4) Lead, lag, dead time, and ratio compensators.

5) Integration and totalization of analog process variables.

14. Furnish a comprehensive database for the analog inputs, calculated values, control modules, and outputs:

    a. In addition, provide spare database points for future expansion.

15. One integrated database can be utilized for all types of analog points or separate databases for each type, in either case the database for each point must include all specified aspects.

16. All portions of the database must be available for use by the display, report, and other specified software modules.

17. All of the data fields and functions specified below must be part of the point definition database at the operator interface. Provide the capability to define new database points through the point display specified below as well as modifying defined points through these displays. This point definition and modification must include all of the features and functions defined below. The analog database software must support the following functions and attributes:

    a. Analog input signal types:

        1) Provide software at the RTUs and PLCs to read variable voltage/current signals and pulse duration/frequency type analog input signals.

    b. Input accuracy:

        1) Inputs must be read with an accuracy of ±0.05 percent full scale or better.

        2) Data conversion errors must be less than 0.05 percent full scale.

        3) Pulse accumulation error less than or equal to 1 count of actual input count at a scan rate of once a minute.

        4) Maintain for a minimum of 1 year the system accuracy stated above without adjustments.

    c. Blocking:

1) Provide mechanisms to inhibit or block the scanning and/or processing of any analog input through the operator interface.

2) For any input so blocked, the operator may manually enter a value to be used as the input value.

d. Filtering:

1) For each analog input provide a first order lag digital filter with an adjustable filter factor.

e. Linearizing:

1) Where analog inputs require square root extraction or other linearization, provide a mechanism to condition the filtered data before the process of scaling and zero suppression takes place.

f. Calculated values:

1) Provide means to allow for pseudo-inputs calculated by algebraic and/or Boolean expressions utilizing real inputs, other calculated value, constants, etc.

2) These values must be handled the same as real inputs in terms of record keeping, alarming, etc.

g. Scaling and zero suppression:

1) Provide a conversion program to convert input values into engineering units in a floating-point format.

h. Alarms:

1) Provide an alarm program to check all analog variables against
high-high, high, low, and low-low alarm limits.

2) When an analog value exceeds a set limit, it must be reported as an alarm based on individually set priority level for each alarm point.

3) Provide an adjustable hysteresis band in order to prevent excessive alarms when a variable is hovering around an alarm limit.

4) Report return to normal shall also be reported.

5) Must be possible to inhibit alarms based on external events, i.e., lock-out low pump flow alarm when the pump is off.

i. Averages:

1) Provide a program to calculate and store hourly, daily, and monthly averages of analog variables.

2) Continuously compute averages, i.e., the average for the current period to the present point in time must be stored in memory and available for use in displays, etc.

3) Update hourly averages each minute or at the polling interval for the selected variable.

4) Update daily averages at least once each hour and calculate using the results of the hourly averages.

5) Update monthly averages at least once each day and calculate using the results of the daily averages.

6) At the end of each averaging period, store the average values for the period on the hard disk for historical record keeping and reset the present period average register to the present value of the variable.

7) The active database must include the present period average and previous period average for each variable and averaging period.

j. Totals:

1) Provide a program to calculate and store hourly, daily, and monthly totalization of analog variables.

2) Assign a scaling factor to each variable to convert to the appropriate units based on a 1-minute totalizing interval.

3) Assign a separate factor for each totalizing interval.

4) Variables for which totalization is inappropriate must have scaling factors of zero.

5) At the end of each totalizing period, store the totalized values for the period on the hard disk for historical record keeping and reset the present period totalization register to zero.

6) The active database must include the present period total and previous period total for each variable and totalizing period.

k. Engineering units:

1) Provide software to allow the system and the operator to convert all the measured analog variables to any desired engineering units.

2) The operator must be able to view displays and generate reports of any measured variable in one or more engineering units such as flow in gpm, mgd, cfs, and acre-feet per day.

3) Pre-program the conversion of the engineering units, and if not pre-programmed, the operator must be able to program new engineering unit conversions by using simple methods, i.e., multiplication of the database attributes by a constant.

4) The programming method must be at a level and compatible with the specified training of the operator and the OWNER's personnel.

5) New conversions must not require the services of a special programmer and/or special, high-level, programming training.

l. Control modules:

1) For each control function configured, whether processed at the RTU, PLC, or operator interface, maintain a file of necessary data including input values, setpoints, constants, intermediate calculated values, output value and limit clamps, etc.

2) Input and output assignments, setpoints, and constants must be adjustable by the operator through the operator interface.

3) Provide control algorithms for manual control with output values adjustable by the operator.

m. Analog outputs:

1) Analog outputs must be maintained as part of the database.

2) These outputs must be adjustable manually by the operator through the operator interface or through automatic control algorithms.

18. Some of the above functions may be better accomplished in the data acquisition and graphic display software package; it is the responsibility of the ICSC to optimize the location of the various functions between all software packages.

B. General control functions:

1. Analog control functions:

a. PID, lead/lag, signal select, alarm, limit, delay, and time base.

b. Furnish the control system complete with a library of mathematical/calculation software to support averaging, weighted average, addition, subtraction, multiplication, division, square root extraction, exponential, AND, OR, NAND, NOR, XOR and NXOR functions.

c. All math utilities must be linkable to process data points or manual inputs via control block configuration.

d. By linking control blocks to data points, the math library must support system unit conversion and calculation requirements.

2. Discrete control functions:

a. AND, OR, NOT, EXCLUSIVE OR, comparators, delays and time base.

3. Software support:

a. Retain in firmware all control and logic functions at each RTU and PLC and in RAM at the operator interface.

b. Call each function as required by the configured controls to perform the intended function.

4. Control and status discrepancies:

a. Generate a discrepancy/fail alarm for any pump, valve, or final control element if a discrepancy exists between a system or operator command and the device status.

b. For example, the system commands to start (call), and the pump fails to start (run status report back), within predetermined operator programmable time delay (time disagree), and then a discrepancy (fail) alarm shall be generated.

c. Involuntary change in the device's status must also generate an alarm:

1) For example, a pump starts when not commanded to do so, or a pump shuts down while running even though it still has a command to run.

d. Each command, status, and alarm must cause the color of the symbol to change.

e. Because many discrete final control elements have a cycle time in excess of the scan interval, provide each control output with an associated delay period selected to be longer than the operating period of the control element:

1) Delay periods for each final control element must be adjustable at the operator interface.

2) List all time delays in the final documentation.

5. Some of the above functions may be better accomplished in the data acquisition and graphic display software package; it is the responsibility of the ICSC to optimize the location of the various functions between all software packages.

C. Control configuration:

1. Provide software to allow control strategies to be developed and their operation initiated through the operator interface.

2. Provide standardized control point displays for defining the control functions including the function type, input/output addresses, setpoints and tuning constants, etc.

3. Provide a mechanism to link separate control functions together into an integrated control strategy.

4. Provide a mechanism to download operational/control setpoints developed at any operator interface to any PLC or RTU for operational implementation.

5. Provide a mechanism to define and implement operational/control setpoints locally at the PLC or RTU and to upload them to the operator interface for operational record keeping.

6. Perform control configurations on-line at the operator interface, the PLC or RTU may be taken off-line when being configured or downloaded.

2.03 SOURCE QUALITY CONTROL

A. As specified in Section 17050.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. The control system logic program shall reside at the PLC level.

B. Use the tag and loop identifications found on the P&IDs for all tags used and/or assigned as part of the application software work provided by the ICSC.

C. Program the PLC logic using Ladder Diagram programming language.

3.02 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

A. Provide a minimum of 4 CD/DVD copies of the following:

1. Application software:

a. Finalized fully annotated, unlocked code and libraries, copy of programmed PLC logic in its native format.

b. Cross-referenced index of all PLC registers or points.

B. Provide un-opened box containing latest version of Modicon Unity Pro XL configuration software, manuals and disks licensed to the Owner two weeks prior to the start of any PLC & OI field testing. Provide and submit proof that software is licensed to Owner when software is delivered to Owner. It is the ICSC's responsibility to obtain PLC configuration software, manuals, and disks necessary for the ICSC to program and configure the PLC. Owner's existing configuration software, manuals and disks shall not be available to the ICSC for use. Submit manufacturer's software license for configuration software supplied under this Section.

3.03 DEMONSTRATION AND TRAINING

A. As specified in Section 17050.

B. Training:

1. Performed by pre-approved and qualified representatives of the ICSC and/or manufacturer of the local operator interface software. A representative of the ICSC may perform the training only if the representative has completed the manufacturer's training course for the PLC programming software.

END OF SECTION

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SECTION 17901

SCHEDULES – FIELD INSTRUMENTS

PART 1 - GENERAL

1.01 SUMMARY

A. The Schedules - Field Instruments is not a take-off list. Additional information is as indicated on the Drawings and specified in the Contract Documents. Where any discrepancies between this list and the P&ID drawings arise, the P&ID shall govern.

B. Abbreviations used in the Instrument Index are defined on the Drawings.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 SCHEDULES FIELD INSTRUMENTS

A. Schedules - Field Instruments attached.

17901 DEVICE INDEX

ITEM	E-DWG	P&ID	DEVICE TAG SITE PRE	SITE #	AREA DESG	PROC DESG	INST ABR	DEVICE TAG #	DESCRIPTION	TYPE	SPECS	MIN NEMA RATING	SIZE	SP / RANGE	UNITS	VOLT	SUN SHIELD UE-33	DWG REF DET MOUNTING	NOTES AND ACCESSORIES
1	-	P2	14	165	10	GW	TSH	101	Temperature Switch	N.C.	11301	-	-	-	-	120Vac		Motor	
2	E33	P2	14	165	10	GW	LT	010	Level Xmtr	Sub	17202	-	-	0-200	FT	24Vdc		UE-30A	+250 feet cable
3	E33	P2	14	165	10	GW	SV	106	Solenoid Valve	N.C.	15100	4X	-	-	-	120Vac		PIPE	
4	E33	P2	14	165	10	GW	MOV	104	Motor Operated Valve	-	15100	4X		-	-	208Vac		PIPE	
5	-	P2	14	165	10	GW	PI	011	Pressure Indicator	GAUGE	17404	-	-	0-200	PSI	-		PIPE	
6	E33	P2	14	165	10	GW	PIT	011	Pressure Indicating Xmtr	GAUGE	17405	4X	-	0-200	PSI	24Vdc		UE-26E	UE-38
7	E33	P2	14	165	10	GW	PSH	017	Pressure Switch	GAUGE	17403	4X	-	15	PSI	120Vac		UE-26F	
8	E33	P2	14	165	10	GW	FE	012	Flow Element	MAG	17302	4X	16"	-	-	-		UA-31A	
9	E33	P2	14	165	10	GW	FIT	012	Flow Indicating Xmtr	MAG	17302	4X	-	0-2500	GPM	24Vdc		UA-31A	UE-38
10	E33	P2	14	165	10	GW	FSL	105	Flow Switch	Paddle	17301	4X	-	5	GPM	120Vac		UA-33	
11	-	P2	14	165	10	GW	FE	022	Flow Element	MAG	FUTURE	4X		-	-	-		-	
12	E33	P3	14	165	20	MH	TSH	202	Temperature Switch	N.C.	11375	-	-	-	-	120Vac		Motor	
13	E33	P3	14	165	20	MH	LIT	030	Level Indicating Xmtr	Radar	17207	-	-	0-10	FT	24Vdc		UE-30C	
14	E33	P3	14	165	20	MH	LSHH	026	Level Switch	FLOAT	17201-2.02.A	-	-	9.5	FT	-		UE-7E	20' CBL
15	E33	P3	14	165	20	MH	LSLL	016	Level Switch	FLOAT	17201-2.02.A	-	-	4'	FT	-		UE-7E	20' CBL
16	E33	P3	14	165	20	MH	TSH	203	Temperature Switch	N.C.	11302	-	-	-	-	120Vac		Motor	
17	-	P3	14	165	20	MH	PI	203	Pressure Indicator	GAUGE	17404	-	-	0-80	PSI	-		PIPE	
18	E33	P3	14	165	20	MH	PIT	031	Pressure Indicating Xmtr	GAUGE	17405	4X	-	0-80	PSI	24Vdc		UE-26E	UE-38
19	E33	P3	14	165	20	MH	PSH	027	Pressure Switch	GAUGE	17403	4X	-	30	PSI	120Vac		UE-26F	
20	-	P3	14	165	20	MH	PI	207	Pressure Indicator	GAUGE	17404	-	-	0-80	PSI	-		PIPE	
21	E33	P3	14	165	20	MH	PIT	041	Pressure Indicating Xmtr	GAUGE	17405	4X	-	0-80	PSI	24Vdc		UE-26E	UE-38
22	E33	P3	14	165	20	MH	PSH	037	Pressure Switch	GAUGE	17403	4X	-	30	PSI	120Vac		UE-26F	
23	E33	P3	14	165	20	MH	TSH	207	Temperature Switch	N.C.	11302	-	-	-	-	-		-	
24	E33	P4	14	165	31	MT	FE	032	Flow Element	MAG	13202	4X	12"	-	-	-		UE-31A	
25	E33	P4	14	165	31	MT	FIT	032	Flow Indicating Xmtr	MAG	13202	4X	-	0-2000	GPM	24Vdc		UE-31A	UE-38
26	E33	P4	14	165	31	MT	MOV	302	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
27	E33	P4	14	165	31	MT	MOV	304	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
28	E33	P4	14	165	31	MT	MOV	306	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
29	E33	P4	14	165	31	MT	MOV	308	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
30	E33	P4	14	165	31	MT	MOV	310	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
31	E33	P4	14	165	31	MT	MOV	312	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
32	E33	P4	14	165	31	MT	MOV	314	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
33	E33	P4	14	165	31	MT	MOV	316	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
34	E33	P4	14	165	31	MT	MOV	318	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
35	E33	P4	14	165	31	MT	PDIT	071	Press Diff Indicating Xmtr	GAUGE	17406	4X	-	0-15	PSI	24Vdc		UE-26E	UE-38
36	-	P5	14	165	32	MT	FE	042	Flow Element	MAG	13202	4X	12"	-	-	-		-	
37	E33	P5	14	165	32	MT	FIT	042	Flow Indicating Xmtr	MAG	13202	4X	-	0-2000	GPM	24Vdc		UNIT	
38	E33	P5	14	165	32	MT	MOV	402	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
39	E33	P5	14	165	32	MT	MOV	404	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
40	E33	P5	14	165	32	MT	MOV	406	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
41	E33	P5	14	165	32	MT	MOV	408	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
42	E33	P5	14	165	32	MT	MOV	410	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
43	E33	P5	14	165	32	MT	MOV	412	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
44	E33	P5	14	165	32	MT	MOV	414	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
45	E33	P5	14	165	32	MT	MOV	416	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	

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ITEM	E-DWG	P&ID	DEVICE TAG SITE PRE	SITE #	AREA DESG	PROC DESG	INST ABR	DEVICE TAG #	DESCRIPTION	TYPE	SPECS	MIN NEMA RATING	SIZE	SP / RANGE	UNITS	VOLT	SUN SHIELD UE-33	DWG REF DET MOUNTING	NOTES AND ACCESSORIES
46	E33	P5	14	165	32	MT	MOV	418	Motor Operated Valve	-	13202	4X	-	-	-	120Vac		UNIT	
47	E33	P5	14	165	32	MT	PDIT	081	Press Diff Indicating Xmtr	GAUGE	17406	4X	-	0-15	PSI	24Vdc		UE-26E	UE-38
48	-	P6	14	165	33	MT	FE	450	Flow Element	MAG	FUTURE	4X		-	-	-		-	
49	-	P6	14	165	33	MT	FIT	450	Flow Indicating Xmtr	MAG	FUTURE	4X	-	-	GPM	24Vdc		UNIT	
50	-	P6	14	165	33	MT	MOV	452	Motor Operated Valve	-	FUTURE	4X	-	-	-	120Vac		UNIT	
51	-	P6	14	165	33	MT	MOV	454	Motor Operated Valve	-	FUTURE	4X	-	-	-	120Vac		UNIT	
52	-	P6	14	165	33	MT	MOV	456	Motor Operated Valve	-	FUTURE	4X	-	-	-	120Vac		UNIT	
53	-	P6	14	165	33	MT	MOV	458	Motor Operated Valve	-	FUTURE	4X	-	-	-	120Vac		UNIT	
54	-	P6	14	165	33	MT	MOV	460	Motor Operated Valve	-	FUTURE	4X	-	-	-	120Vac		UNIT	
55	-	P6	14	165	33	MT	MOV	462	Motor Operated Valve	-	FUTURE	4X	-	-	-	120Vac		UNIT	
56	-	P6	14	165	33	MT	MOV	464	Motor Operated Valve	-	FUTURE	4X	-	-	-	120Vac		UNIT	
57	-	P6	14	165	33	MT	MOV	466	Motor Operated Valve	-	FUTURE	4X	-	-	-	120Vac		UNIT	
58	-	P6	14	165	33	MT	MOV	468	Motor Operated Valve	-	FUTURE	4X	-	-	-	120Vac		UNIT	
59	-	P6	14	165	33	MT	PDIT	091	Press Diff Indicating Xmtr	GAUGE	FUTURE	4X	-	0-15	PSI	24Vdc		UE-26E	UE-38
60	E33	P7	14	165	40	BK	LSHH	036	Level Switch	FLOAT	17201-2.02.A	-	-	15.5"	ELEV	120Vac		UE-7C	50' CBL
61	E33	P7	14	165	40	BK	LIT	040	Level Indicating Xmtr	ULTRA	17206	-	-	0-20	FT	24Vdc		UE-30B	UE-38
62	-	P7	14	165	40	BK	LI	040	Level Indicator	-	13212	-	-	PER MNFR	FT	-		-	
63	E33	P7	14	165	40	BK	MOV	349	Motor Operated Valve	-	15100	4X	-	-	-	120Vac		UNIT	
64	E33	P7	14	165	40	BK	FE	052	Flow Element	MAG	17302	4X	6"	-	-	-		UE-31B	
65	E33	P7	14	165	40	BK	FIT	052	Flow Indicating Xmtr	MAG	17302	4X	-	0-400	GPM	24Vdc		UE-31B	
66	E40C	P8	16	800	81	CL	WE	014	Weight Element	Scale	11261	4X	-	-	-	-		UNIT	
67	E40C	P8	16	800	81	CL	WIT	014	Weight Indicating Xmtr	Scale	11261	4X	-	0-300	LBS	120Vac		WALL	
68	E40C	P8	16	800	81	CL	WE	024	Weight Element	Scale	11261	4X	-	-	-	-		UNIT	
69	E40C	P8	16	800	81	CL	WIT	024	Weight Indicating Xmtr	Scale	11261	4X	-	0-300	LBS	120Vac		WALL	
70	E40C	P8	16	800	81	CL	AE	033	Analytical Element	CL2 Gas	17601	4X		0-25	PPM	-		WALL	
71	E40C	P8	16	800	81	CL	AIT	033	Analytical Indicating Xmtr	CL2 Gas	17601	4X	-	0-25	PPM	120Vac		WALL	Relay Outputs
72	E40C	P8	16	800	81	CL	AE	043	Analytical Element	CL2 Gas	17601	4X		0-5	PPM	-		WALL	
73	E40C	P8	16	800	81	CL	AIT	043	Analytical Indicating Xmtr	CL2 Gas	17601	4X	-	0-5	PPM	120Vac		WALL	Relay Outputs
74	E40C	P8	16	800	81	CL	ZS	807	Auto Changeover Switch	-	11260	4X	-	-	-	24Vdc		M602	Relay Outputs
75	-	P9	16	800	83	FL	LSHH	056	Level Switch	FLOOD	11270	4X	-	-	-	-		UNIT	
76	-	P9	16	800	83	FL	LSH	046	Level Switch	-	11270	4X	-	PER MNFR	FT	120Vac		UNIT	
77	-	P9	16	800	83	FL	FI	082	Flow Indicating Xmtr	Prop	11270	4X	-	PER MNFR	GPM	-		UNIT	
78	-	P9	16	800	83	FL	SV		Solenoid Valve	N.C.	11270	4X	-	-	-	120Vac		UNIT	
79	E40C	P9	16	800	83	FL	PNL	849	Control Panel	-	11270	4X	-	-	-	120Vac		UNIT	
80	E40C	P9	16	800	80	FR	AE	013	Analytical Element	CL2 Res	17505	4X	-	-	-	120Vac		M603	
81	E40C	P9	16	800	80	FR	AIT	013	Analytical Indicating Xmtr	CL2 Res	17505	4X	-	0-4.0	PPM	120Vac		M603	
82	E40C	P9	16	800	80	FR	AE	023	Analytical Element	FL Res	17507	4X	-	0-2.0	PPM	120Vac		M603	
83	E40C	P9	16	800	80	PH	AE	073	Analytical Element	pH	17501	4X	-	-	-	-		M603	
84	E40C	P9	16	800	80	FR	AIT	073	Analytical Indicating Xmtr	pH	17501	4X	-	0-14	pH	120Vac		M603	
85	E40C	P9	16	800	80	FR	AE	083	Analytical Element	Turbidity	17509	4X	-	-	-	-		M603	
86	E40C	P9	16	800	80	FR	AIT	083	Analytical Indicating Xmtr	Turbidity	17509	4X	-	0-1	NTU	120Vac		M603	
87	-	P9	16	800	60	FW	AE	063	Analytical Element	CL2 Res	17505	4X	-	-	-	-			
88	E40C	P9	16	800	60	FW	AIT	063	Analytical Indicating Xmtr	CL2 Res	17505	4X	-	0-2.0	PPM	120Vac		M603	
89	E34	P10	16	800	60	FW	FE	092	Flow Element	MAG	17302	4X	16"	-	-	-		UE-31A	
90	E34	P10	16	800	60	FW	FIT	092	Flow Indicating Xmtr	MAG	17302	4X	-	0-8000	GPM	24Vdc		UE-31A	UE-38
91	E34	P10	16	800	60	FW	ACV	601	Altitude Ctrl Valve	-	15220	4X	-	-	-	120Vac		PIPE	SV601O/C, ZT601

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ITEM	E-DWG	P&ID	DEVICE TAG SITE PRE	SITE #	AREA DESG	PROC DESG	INST ABR	DEVICE TAG #		DESCRIPTION	TYPE	SPECS	MIN NEMA RATING	SIZE	SP / RANGE	UNITS	VOLT	SUN SHIELD UE-33	DWG REF DET MOUNTING	NOTES AND ACCESSORIES
92	E31	P10	16	800	50	ST	LSHH	066		Level Switch	FLOAT	17201-2.02.A	-	-	44.7	ELEV	24Vdc		UE-7C	30' CBL
93	E31	P10	16	800	50	ST	LSLL	066		Level Switch	FLOAT	17201-2.02.A	-	-	19.4	ELEV	120Vac		UE-7C	80' CBL
94	E31	P10	16	800	50	ST	LIT	050		Level Indicating Xmtr	Radar	17207	-	-	0-28	FT	24Vdc		UE-30C	
95	-	P10	16	800	50	ST	LI	050		Level Indicator	-	05502	-	-	PER MNFR	FT	-		Per Mnfr	
96	E31	P10	16	800	50	ST	ZS	019		Position Switch	N.C.	16752-2.05	4X	-	-	-	24Vdc		HATCH	
97	-	P10	16	800	51	ST	TSH	511		Temperature Switch	N.C.	11358	-	-	-	-	-		Motor	
98	-	P10	16	800	51	ST	MSH	511		Moisture Switch	N.C.	11358	-	-	-	-	-		Motor	
99	E31	P10	16	800	51	ST	LSHH	076		Level Switch	FLOAT	17201-2.02.A	-	-	27.5	ELEV	24Vdc		UE-7E	20' CBL
100	E31	P10	16	800	51	ST	LSH	076		Level Switch	FLOAT	17201-2.02.A	-	-	8.5	ELEV	120Vac		UE-7E	20' CBL
101	E31	P10	16	800	51	ST	LSX	076		Level Switch	FLOAT	17201-2.02.A	-	-	6.5	ELEV	24Vdc		UE-7E	60' CBL
102	E31	P10	16	800	51	ST	LSLL	076		Level Switch	FLOAT	17201-2.02.A	-	-	5.5	ELEV	24Vdc		UE-7E	60' CBL
103	E40C	P11	16	800	60	FW	PNL	611		Control Panel	VFD	16483	12	-	-	-	480Vac		UE-20A	
104	E40C	P11	16	800	60	FW	PNL	612		Control Panel	VFD	16483	12	-	-	-	480Vac		UE-20A	
105	-	P11	16	800	60	FW	TSH	611		Temperature Switch	N.C.	11303	-	-	-	-	120Vac		Motor	
106	-	P11	16	800	60	FW	TSH	612		Temperature Switch	N.C.	11303	-	-	-	-	120Vac		Motor	
107	-	P11	16	800	60	FW	TSH	613		Temperature Switch	N.C.	11303	-	-	-	-	120Vac		Motor	
108	-	P11	16	800	60	FW	TSH	614		Temperature Switch	N.C.	11303	-	-	-	-	120Vac		Motor	
109	-	P11	16	800	60	FW	ZS	611		Position Switch	Suprv	16010	-	-	-	-	24Vdc		-	
110	-	P11	16	800	60	FW	ZS	612		Position Switch	Suprv	16010	-	-	-	-	24Vdc		-	
111	-	P11	16	800	60	FW	ZS	613		Position Switch	Suprv	16010	-	-	-	-	24Vdc		-	
112	-	P11	16	800	60	FW	ZS	614		Position Switch	Suprv	16010	-	-	-	-	24Vdc		-	
113	E34	P11	16	800	60	FW	PSH	611		Pressure Switch	GAUGE	17403	4X	-	50	PSI	120Vac		UE-26F	
114	E34	P11	16	800	60	FW	PSH	612		Pressure Switch	GAUGE	17403	4X	-	50	PSI	120Vac		UE-26F	
115	E34	P11	16	800	60	FW	PSH	613		Pressure Switch	GAUGE	17403	4X	-	50	PSI	120Vac		UE-26F	
116	E34	P11	16	800	60	FW	PSH	614		Pressure Switch	GAUGE	17403	4X	-	50	PSI	120Vac		UE-26F	
117	-	P11	16	800	60	FW	PI	611		Pressure Indicator	GAUGE	17404	-	-	0-80	PSI	-			
118	-	P11	16	800	60	FW	PI	612		Pressure Indicator	GAUGE	17404	-	-	0-80	PSI	-			
119	-	P11	16	800	60	FW	PI	613		Pressure Indicator	GAUGE	17404	-	-	0-80	PSI	-			
120	-	P11	16	800	60	FW	PI	614		Pressure Indicator	GAUGE	17404	-	-	0-80	PSI	-			
121	E34	P11	16	800	60	FW	PIT	061		Pressure Indicating Xmtr	GAUGE	17405	4X	-	0-80	PSI	24Vdc		UE-26E	UE-38
122	E34	P11	16	800	60	FW	ZS	029		Position Switch	N.C.	16752-2.05	4X	-	-	-	24Vdc		HATCH	
123	E34	P11	16	800	60	FW	LSH	086		Level Switch	Flood	17201-2.02.B	4X	-	-	-	24Vdc		UE-32	
124	E40A	P12	16	800	90	MS	ZS	039	A~J	Position Switch	N.C.	16752	4X	-	-	-	-		DOOR	
125	E40C	P12	16	800	90	MS	FSH	038		Flow Switch	N.C.	15410	4X	-	PER MNFR	-	-		PIPE	
126	E40A	P12	16	800	90	MS	PE	059		Photocell	-	16500-2.01.J	4	-	-	-	120Vac		WALL	
127	E31	P12	16	800	90	MS	MS	079	A~D	Motion Switch	-	16500-2.01.I	IP 54	-	-	-	120Vac		UE-10A	
128	E40D	P12	16	800	90	MS	TIT	093		Temperature Ind Xmtr	-	17602	4X	-	32-110	°F	120Vac		WALL	
129	E40C	P12	16	800	90	MS	PNL	039		Control Panel	-	16752	12	-	-	-	120Vac		WALL	
130	E31	P12	16	800	90	MS	PNL	049		Control Panel	-	02820	4X	-	-	-	120Vac		Per Mnfr	
131	E31	P12	16	800	90	MS	GMU	049		Gate Operator	-	02820	4X	-	-	-	208Vac		Per Mnfr	
132	E40C	P12	16	800	90	MS	FACP			Control Panel	-	16710	12	-	-	-	120Vac		WALL	

SECTION 17903

SCHEDULES – I/O LIST

PART 1 - GENERAL

1.01 SUMMARY

A. The I/O list is not a take-off list. Additional information is as indicated on the Drawings and specified in the Contract Documents. Where any discrepancies between this list and the P&ID drawings arise, the P&ID shall govern.

B. Abbreviations used in the I/O list are defined on the Drawings.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 I/O LIST

A. I/O list attached.

SHASTA PARK WATER FACILITY
PLC I/O LIST
RACK 1, SLOT 8 - ANALOG INPUTS AI

I/O #	P & ID	SCADA/PLC TAG Site Pre	Site #	Area Desg	Proc Desgn	Tagname		Description	Low Range	High Range	Eng Units
1	P2	14	165	10	GW	L	010	Well 165 Level	0	200.00	FT
2	P2	14	165	10	GW	P	011	Well 165 Discharge Pressure	0	200.00	PSI
3	P2	14	165	20	GW	L	020	Well 166 Level (F)			FT
4	P2	14	165	20	GW	P	021	Well 166 Discharge Pressure (F)			PSI
5	P3	14	165	20	MH	L	030	Methane Sump Level	0	10.00	FT
6	P3	14	165	20	MH	P	031	Raw Water Booster Pump 1 Pressure	0	80.00	PSI
7	P3	14	165	20	MH	P	041	Raw Water Booster Pump 2 Pressure	0	80.00	PSI
8								Spare			

SECTION 17950

TESTING, CALIBRATION AND COMMISSIONING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Testing requirements that apply to all process control and instrumentation systems for the entire Project Grounding electrode conductors.

B. Related sections:

1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.

2. It is the CONTRACTOR's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of CONTRACTOR's Work.

3. The following sections are related to the Work described in this Section. This list of related sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the CONTRACTOR to see that the completed Work complies accurately with the Contract Documents.

a. Section 01140 - Work Sequence and Constraints.

b. Section 01410 - Quality Control.

c. Section 01330 - Submittal Procedures.

d. Section 01750 - Testing, Training, and Facility Start-Up.

e. Section 16950 – Field Electrical Acceptance Tests.

f. Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

g. Section 17100 - Control Strategies.

1.02 REFERENCES

A. As specified in Section 17050.

1.03 DEFINITIONS

A. As specified in Section 17050.

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330.

B. General:

1. Reference additional detailed test submittal scheduling and prerequisite requirements as specified in the Sequencing article of Section 17050.

2. For each test described in Parts 2 and 3 of this Section, and described in other sections of the Instrumentation and Control Specifications, prepare and submit complete test plans, test procedures, test forms, test binders, test reports, and other submittals, as specified below.

3. Submit manufacturer's certifications and manufacturer's field reports where required.

4. Submit test plans, procedures, forms, and binders for approval by the ENGINEER before scheduling or performing tests.

5. Develop the PCIS system test submittals in consultation and cooperation with all applicable subcontractors.

6. Additional test form and test procedure requirements are specified with individual test requirements.

C. Overall test plan:

1. Develop and submit an overall testing plan for the PCIS. The overall test plan to be reviewed and approved by the ENGINEER before detailed test plans, procedures, and forms will be reviewed.

2. Describe the test phases as they apply specifically to this Project and each process system.

3. Provide a preliminary testing schedule to show the sequence of tests and commissioning as they apply to each process system and each PLC.

4. Provide a description of factory tests. Describe what equipment will be included, what testing equipment will be used, and the simulator that will be used.

5. Provide examples of proposed forms and checklists.

D. Test procedures:

1. Develop and submit detailed test procedures to show that the integrated SCADA system hardware and software is fully operational and in compliance with the requirements specified in the Contract Documents.

2. Provide a statement of test objectives for each test.

3. Prepare specific procedures for each process system.

4. Describe sequentially the steps to be followed in verifying the correct operation of each process system, including all features described in the loop descriptions, control strategies, and shown in the P&IDs. Implied or generic test procedures are not acceptable.

5. Specify who will perform the tests, specifically what testing equipment will be used (including serial numbers and NIST-traceable calibration), and how the testing equipment will be used.

6. Describe the expected role of the ENGINEER, as well as any requirements for assistance from OWNER's staff.

7. Provide the forms and checklists to be used.

E. Test Forms:

1. Provide test forms and checklists for each of the following:
    a. Calibration.
    b. Factory acceptance tests.
    c. Panel enclosure tests.
    d. Loop validation tests.
    e. Pre-commissioning test.
    f. Performance test.
2. Test forms shall include the detailed test procedures, or shall include clear references to separate pages containing the complete test procedure applicable to each form. If references to procedures are used, the complete procedure shall be included with each test binder. Testing shall not commence until the test procedures have been reviewed and approved by the OWNER.
3. Every page of each test form shall include project name, date, time, name of person conducting the test, signature of person conducting the test, and for witnessed tests, place for signature of person (ENGINEER and OWNER) witnessing the test.
4. Factory acceptance test forms shall be submitted separately from the other test procedures and forms.

F. Testing binders:
1. Sub-system to be tested, provide and submit a test binder containing all test procedures and individual test forms for the test. References to other documents for test procedures and requirements are not acceptable.
2. Fill out in advance headings and all other information known before the test.
3. Include applicable test plan information, as well as a list of all test prerequisites, test personnel, and equipment.
4. Include or list reference material and provide separately at the time of the test.
5. Record test results and verify that all test requirements and conditions have been met.

G. Factory acceptance test procedure additional minimal requirements:
1. Prepare and submit a factory acceptance test procedure which includes:
    a. Control system testing block diagram.
    b. Estimated test duration.
    c. Details on the simulator construction, components, and operation.
2. Engineer reserves the right to postpone the factory test, at no additional cost to the OWNER, until the submittal(s) associated with the factory test has been reviewed by the Engineer and marked "No Exceptions Taken" or "Make Corrections Noted." No extension of Contract time will be allowed.

H. Test reports:

1. At the conclusion of each test, submit a complete test report, including all test results and certifications.
2. Include all completed test binders, forms, and checklists.
3. Submission, review, and acceptance of each test report is generally required before the start of the sub-system.

1.05 QUALITY ASSURANCE

A. Test personnel:

1. Furnish experienced qualified technical personnel to perform all calibration, testing, and verification. The test personnel are required to be familiar with this Project and the equipment, software, and systems before being assigned to the test program.
2. The OWNER and ENGINEER reserves the right to halt the factory test and request that the technical personnel be replaced if they find the work substandard or personnel unqualified to perform the factory test in their opinion at no additional cost to Owner.

1.06 SCHEDULING

A. As specified in Section 17050.

PART 2 - PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Factory acceptance test - general:

1. Before shipment to the Project Site, the complete PCIS system including all operator stations, servers, network equipment, printers, PCMs, PLCs, RTUs, LCPs, CCS, peripherals, communications equipment, and other SCADA equipment, shall be assembled, connected, and all software loaded for a fully functional factory acceptance test (FAT) of the integrated system.
2. Perform tests to show that the integrated system hardware and software is fully operational and in compliance with the requirements specified in the Contract Documents. Factory testing is to ensure that there are no defects. The hardware and software shall be tested for compliance with the plans and Specifications included herein and for the ability to perform the control functions.
3. Additional factory tests are specified in other sections of the Instrumentation and Control Specifications.
4. The CONTRACTOR's test personnel shall be responsible for performing tests and recording results.
5. The FAT will be witnessed by the ENGINEER and/or other representatives of the OWNER.

6. Right of observation: The OWNER retains the right to observe all factory test activities including any and all subsystem preparation, pretests, troubleshooting, retests, warm-up, and software modification and/or update. The OWNER and Engineer shall have unlimited and unrestricted access to the usage and testing of all hardware and software in the system under the supervision of the System Supplier.

7. The OWNER reserves the right to test any specified function, whether or not explicitly stated in the test submittal.

8. Costs for repeating testing: The CONTRACTOR shall pay for ENGINEER's and other OWNER's representatives' travel, subsistence, and labor costs for witnessing the repetition of failed tests and/or FAT that was not completed within the length of time specified herein.

9. Correction of deficiencies: Any deficiencies observed during the test shall be corrected and retested before completion of the test.

    a. If the results of any of tests are unacceptable to the Engineer, the Contractor shall make corrections and perform the tests again until they are acceptable to the Engineering; these additional tests shall be done at no additional cost to the OWNER.

    b. Any system material or workmanship which is found defective on the basis of acceptance tests shall be reported to the Engineer. The Contractor shall replace the defective material or equipment and have tests repeated until test proves satisfactory to the Engineer without additional cost to the OWNER.

    c. Faulty and/or incorrect hardware operation of major portions of the system may, at the discretion of the OWNER or Engineer, be cause for suspension or restarting of the entire factory test, at no additional cost to the OWNER or extension in contract time

10. Any changes and/or corrections shall be noted on the test forms. ENGINEER shall witness the revisions and/or corrections prior to leaving the test site.

11. Original PLC/HMI/SCADA programmer(s) shall be present during the entire Factory Test for modifying or adjusting all PLC registers, SCADA application, setpoints, etc. to test the system.

12. The System supplier shall conduct a thorough and complete factory test by qualified factory-trained personnel witnessed by OWNER per the criteria specified herein. Factory test shall be held within 150 miles of project location. All factory tests shall be conducted at the Supplier's facility.

13. Provide a complete clean copy of System Supplier drawings for OWNER and Engineer's use during Factory Test prior to starting the tests. These drawings shall reflect the equipment being tested.

    a. If OWNER Representative determines that these drawings do not adequately reflect the actual equipment being tested or differs substantially from the approved equipment submittal, the OWNER Representative reserves the right to cancel the Factory Test as the equipment is found to be not fully and completely ready for factory testing.

b. Equipment that differs substantially from the approved equipment submittal shall be resubmitted. Factory test will be rescheduled after revised submittals have been reviewed by the Engineer and marked "No Exceptions Taken" or "Make Corrections Noted".

c. No extension of Contract time will be allowed. Cancellation and rescheduling of factory tests shall occur at no additional costs to OWNER

14. Acceptance and witnessing of the factory tests does not relieve or exclude the Contractor from conforming to the requirements of the Contract Documents.

15. The length of the factory testing shall be a maximum of ten (10) working days (8 hours per day).

B. If the corrections and/or revisions are too extensive to be made while the ENGINEER is scheduled to be at the FAT test site, the FAT shall be, at the ENGINEER's sole discretion, considered failed, and the test shall be restarted at a later date. All costs for the re-test shall be borne by the CONTRACTOR. Testing simulation:

1. The FAT shall make use of hardware simulators that contain switches, pilot lights, variable analog signal generators, and analog signal level displays, which shall be connected to the I/O points within the SCADA system. All inputs and outputs shall be simulated and proper control and system operation shall be validated. Each switch, pilot light, display, etc. shall be labeled in accordance with the P&IDs so that a timely and thorough test of the complete system can be conducted.

2. The use of jumper wires, terminal block mounted pilot lights, and loose meters to act as or supply the functionality of a simulator shall not be allowed.

C. The hardware simulator may consist of a PLC, operating under a SCADA software package, or other approved software that has its I/O points wired to PLC's I/O points. Software operating on a PC may then act as the switches, pilot lights, variable analog signal generators, and analog signal level displays. Preliminary factory acceptance test:

1. A complete preliminary factory acceptance test (pre-FAT) shall be conducted utilizing test procedures approved by the ENGINEER. The pre-FAT test procedure shall be a subset of the full FAT.

2. The purpose of the pre-FAT is to provide assurance to the ENGINEER that the SCADA system is ready for the full, witnessed factory acceptance test, in terms of both stability and functionality. Debugging of software and troubleshooting of hardware shall occur during and before the pre-FAT, not during the FAT. The CONTRACTOR shall fully test the SCADA system and fix all deficiencies found before the full FAT.

3. The OWNER shall have the right to witness any or all of the pre-FAT testing and shall be notified in writing 20 days before the start of the pre-FAT.

4. The pre-FAT test results submittal shall include a letter, signed by the CONTRACTOR's project manager or company officer, certifying that the system is complete, has been tested successfully, and is fully ready for the

full, witnessed FAT. The submittal shall include completed pre-FAT test forms, signed by the CONTRACTOR's staff, and shall be submitted for review before the start of the FAT.

D. Panel inspections:

1. The ENGINEER will inspect each control panel for completeness, workmanship, fit and finish, and compliance with the Contract Documents and the approved shop drawings.

2. Provide panel inspection forms as part of the factory acceptance test procedures submittal.

3. Inspection to include, as a minimum: Layout, mounting, wire and data cable routing, wire tags, power supply, components and wiring, I/O components layout (including terminals, wiring and relays), nameplates, starter size, breaker size, device layout on doors and front panels, and proper ventilation operation.

E. I/O test:

1. Verify that I/O is properly wired to field terminals and is properly mapped into the PLC and the rest of the SCADA system, including all operator interface devices.

2. Test methodology:

a. Use the submitted and approved system simulator for this test.

b. Discrete inputs: Apply appropriate input from simulator at panel terminal, observe input card indicator, observe data value at each indicated data address, observe data received on all operator interface displays (SCADA workstations and local operator interface (LOI) displays).

c. Discrete outputs: Issue commands from operator interface screen, verify output card indicator light and measure response on simulator. Repeat for each operator interface screen.

d. Analog inputs: Apply appropriate analog input signal at panel terminals on simulator, observe data value at each indicated data address, and observe data properly received at each operator screen. Check each point at 0 percent, 50 percent, and 100 percent of scale.

e. Analog outputs: Enter scaled values in the output buffer file, observe the output data file value, and measure appropriate response on simulator.

f. All spares shall be tested to terminal blocks.

3. Test forms to include, but not be limited to:

a. PLC and panel number.

b. I/O type.

c. I/O tag name.

d. Panel terminal block numbers.

e. Rack/slot/number of I/O point.

f. Check-off for correct response for each I/O point.

g. Space for comments.

h. Initials of individual performing test.

i. Date test was performed.

j. Witness' signature lines.

F. System configuration test:

1. Demonstrate and test the setup and configuration of all operator stations, servers, development stations, and peripherals.

2. Demonstrate all utility software and functions, such as virus protection, backup, optical drive burning, network monitoring, etc.

3. Demonstrate the proper operation of all peripheral hardware.

4. Demonstrate all general SCADA functions.

5. Demonstrate proper operation of log-on and other access security functions.

6. Demonstrate the proper operation of all historical data storage, trend, display, backup, and report functions.

7. Test automatic fail over of redundant equipment.

8. Demonstrate the proper operation of the alarm display and acknowledgement functions.

9. Test forms:

a. For each test, list the specification page and paragraph of the function demonstrated, and provide a description of the function.

b. List the specific tests and steps to be conducted.

c. For each function, list all of the different sub-functions or ways the function can be used, and provide a test check-off for each:

d. Include signature and date lines.

G. Control logic test:

1. The purpose of this test is to verify that all software functions and logic work as specified, along with any hardwired logic or functions in the tested control panels.

2. Use the submitted and approved system simulator for this test.

3. Testing requirements:

a. Demonstrate each function described in Section 17100. Demonstrate in detail how each function operates under a variety of operating scenarios. Test to verify the application of each general control strategy function to each specific control strategy or loop description.

b. Demonstrate the proper operation of the programming and configuration for each control strategy or loop description. Test each strategy or loop description on a sentence by sentence and function by function basis. Loops with similar or identical logic must each be tested individually.

c. Demonstrate the proper operation of all digital communication links and networks. Verify each digital communication I/O point.

d. Failure testing: In addition to demonstrating correct operation of all specified features, special effort shall be made to demonstrate how the system responds to and recovers from abnormal conditions including, but not limited to: equipment failure, operator error, communications subsystem error, communications failures, simulated/forced software lockups, power failure (both utility power and power to SCADA hardware), process equipment failure, and high system loading conditions.

4. Test forms:

a. Include the fully revised and approved loop description for the loop being tested.

b. Identify the cause and effect as each I/O point is toggled through the simulator. Check boxes shall be provided to track proper and/or improper operation of the loop.

c. Any deficiencies or operational changes shall be noted on the forms for correction and documentation:

1) Include signature and date lines.

5. SCADA Demonstration Test: During the field SCADA Demonstration testing all PLC I/O will be verified by ENGINEER at Area HMI client. Tests will be done on a Project Area by Area basis. Provide 80 hours of on-site Instrumentation Supplier support in bid, travel time shall not be accounted for in hours of on-site Instrumentation Supplier support. CONTRACTOR shall provide two weeks for SCADA Demonstration Test at the site. SCADA Demonstration Tests for each area shall not overlap or be scheduled concurrently. SCADA Demonstration Test shall not be scheduled until Functional Loop Testing (Analog and Discrete) and Control and Logic System Testing is completed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. As specified in Section 17050.

B. Installation supervision:

1. Provide as specified in Section 17050.

3.02 FIELD QUALITY CONTROL

A. General:

1. The OWNER reserves the right to test any specified function, whether or not explicitly stated in the test submittals.

2. Failure testing:

   a. In addition to demonstrating correct operation of all specified features, demonstrate how the system reacts and recovers from abnormal conditions including, but not limited to:

      1) Equipment failure.

      2) Operator error.

      3) Communications sub-system error.

      4) Power failure.

      5) Process equipment failure.

      6) High system loading conditions.

3. Conduct testing Monday through Friday during normal working hours for no more than 8 hours per day. Testing at other times requires approval of the ENGINEER.

B. Manufacturer services:

1. Provide as specified in Section 17050.

C. Sequencing:

1. See additional requirements specified in the Sequencing article of Section 17050.

D. Calibration:

1. After installation but before starting other tests, calibrate and adjust all instruments, devices, valves, and systems, in conformance with the component manufacturer's instructions and as specified in these Contract Documents.

2. Components having adjustable features are to be set carefully for the specific conditions and applications of this installation. Test and verify that components and/or systems are within the specified limits of accuracy.

3. Replace either individually or within a system, defective elements that cannot achieve proper calibration or accuracy.

4. Calibration points:

   a. Calibrate each analog instrument at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span, using test instruments with accuracies traceable to National Institute of Standards and Technology (NIST).

5. Field verify calibration of instruments that have been factory-calibrated to determine whether any of the calibrations are in need of adjustment.

6. Analyzer calibration:

a. Calibrate and test each analyzer system as a workable system after installation. Follow the testing procedures directed by the manufacturers' technical representatives.

7. Complete instrument calibration sheets for every field instrument and analyzer.

8. Calibration tags:

a. Attach a calibration and testing tag to each instrument, piece of equipment, or system.

b. Sign the tag when calibration is complete.

E. LAN cable post-testing:

1. After installing the cable and connectors, test all cables using the LAN certification to confirm the installation meets the requirements of the specification.

2. Provide test documentation that includes the cable number, total length of cable, a permanent hard copy, as well as an ASCII-formatted diskette copy of all traces.

3. After installing connectors:

a. Perform cable end-to-end testing on all installed cables from both ends of the cable. Test shall include cable system performance tests and confirm the absence of wiring errors.

b. Submit a signed test report presenting the results of the cable testing.

c. Repair or replace any portions of the system not meeting TIA standards for a Category 6 installation. Repaired sections shall be retested.

4. Submit 3 copies of all final documentation (including traces), using the approved test form, to the ENGINEER upon successful completion of the testing.

F. Industrial network testing:

1. Modbus test procedures:

a. Provide qualified personnel and test equipment required to conduct the inspection and test procedures as specified herein.

b. The scope of qualification and testing services is based on the network representation as indicated on the Drawings. The scope of qualification and testing services shall include the following network types:

1) Modbus networks.

c. Network qualification and testing activities:

1) Network installation qualification, testing, and documentation:

a) This qualification and testing activity focuses on the physical media and its installation.

b) Conduct a physical inspection to establish the network configuration:

(1) Validate the node type and quantity.

(2) Identify improper installation and damaged components.

(3) Validate integrity of cables and connectors via a physical media test to confirm the signal propagation capabilities of the network media.

(4) Corrective measures shall be recommended based on the results of the inspections and testing.

2) Network operations qualification, testing, and documentation:

a) This qualification and testing activity takes place after the network is commissioned and is under normal operating conditions.

b) The network performance is monitored and measured using non-intrusive test equipment and procedures.

c) The test results are analyzed and corrective measures recommended.

3) Report:

a) Prepare a report that documents the results of the qualification and testing activities.

b) Document the installed condition of the network and provide baseline values for future network maintenance and testing activities.

c) The report to include, but not limited to, the following:

(1) Executive summary for each network.

(2) Inspection and test results for each network.

(3) Calculated network parameters.

(4) Recommendations.

(5) Description of test procedures and required test equipment.

4) Network agency specifications:

a) The testing and qualifications services will adhere to the recommended standards and practices of the referenced standards bodies and agencies:

(1) Modbus networks.

(2) Modbus network requirements, application specifications, designs, and services shall be in conformance with the applicable PTO specifications.

5) Manufacturer's specifications and guidelines:

a) Include all applicable manufacturer's specifications and guidelines.

b) Manufacturer's specifications and guidelines may supersede the specifications of the applicable governing body for the associated network.

6) Test sequence and responsibilities:

a) All qualification and testing activities will be conducted by the CONTRACTOR. Figure 1, Network Test Sequence and Responsibilities, defines the general test sequence:

(1) Before commencing any network inspection or testing activities, verify that all network segments and nodes are in their final installed condition.

(2) The installer to provide all necessary components and labor required to address changes required to bring the network into compliance. The installer shall be available at the time of network inspection and testing to address network deficiencies.

(3) Before commencing any network inspection or testing activities, inspect all network components and all deficiencies addressed.

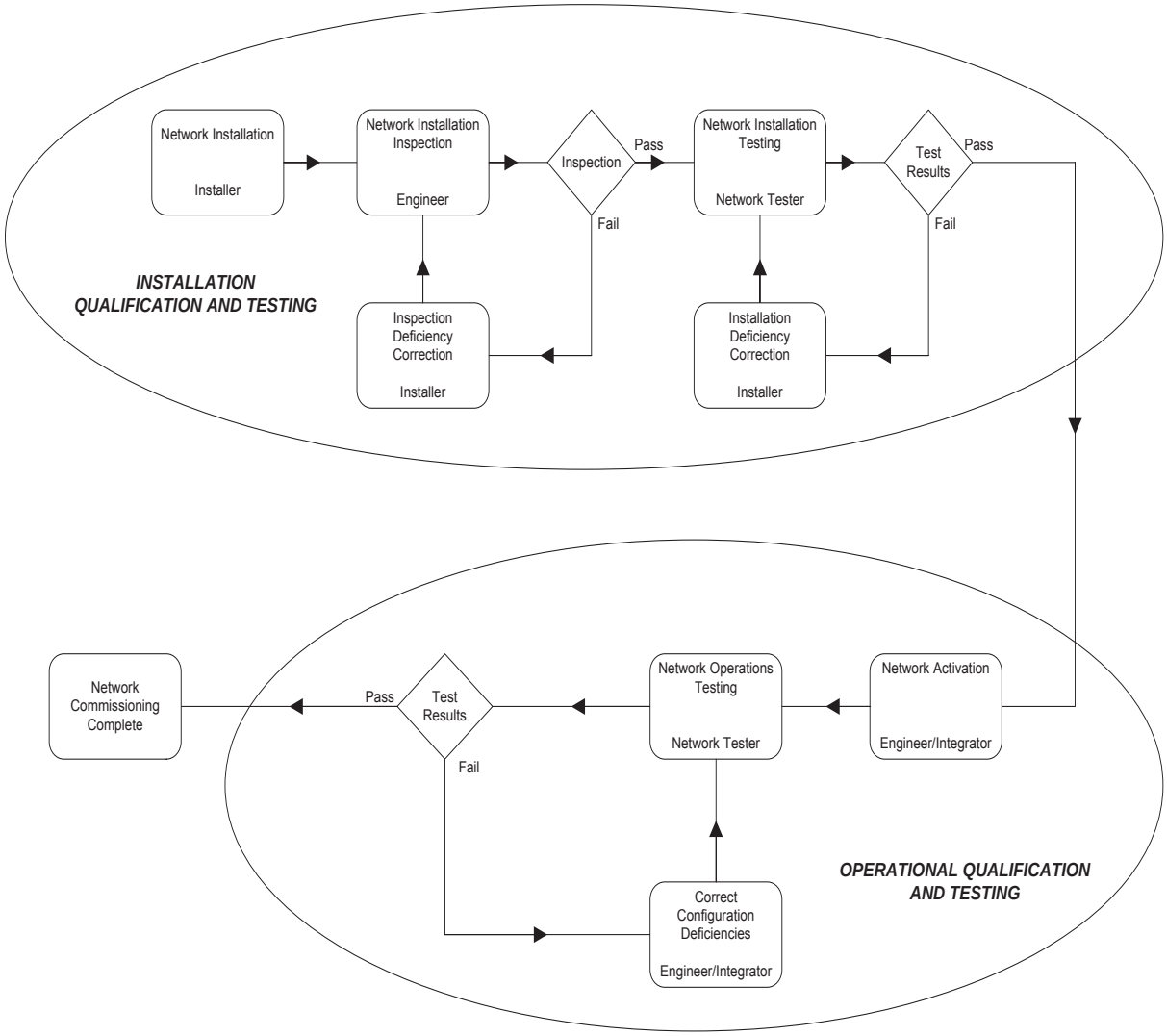

Figure 1
Network Test Sequence and Responsibilities

7) Modbus test procedure:

a) The following prerequisite conditions must be completed before commencing the qualification and testing activities:

(1) Installation qualification and testing:

(a) All cabling installed, terminated, and labeled.

(b) All network node devices installed.

(c) All node devices physically disconnected from the network.

(2) Manufacturer's data and specifications for all installed network components, available on-site for use by the network testing firm.

(3) A complete set of construction drawings and specifications with all addenda and change orders are available on-site for use by the network testing firm.

8) Operations qualification and testing:

a) Network installation qualification and testing successfully completed.

b) Network is commissioned and is operating under normal conditions.

c) Process and process equipment is not dependent on operation of the network:

2. Network operation may be interrupted for inspection and testing.

3. Test equipment:

a. The following test equipment will be utilized in the execution of the described qualification and testing procedures.

1) Network line analyzer Oscilloscope, Fluke Scopemeter Series 190 or equivalent.

2) Digital VOM, Fluke 87 Multimeter or equivalent.

3) Network bus monitor

4. Installation qualification and test procedures:

a. Visual and mechanical inspection:

1) Compare network devices nameplate data with drawings and specifications.

2) Confirm network components are PTO compliant.

3) Verify labeling of all trunk cables.

4) Confirm minimum cable distance between nodes.

5) Verify the presence/absence of stub lines.

6) Verify network terminators are in place.

7) Verify power supply source and connections for active terminations.

8) Verify total network node count.

9) Verify power supply specifications including quantity, ratings, locations, and configuration. Verify power supply source of supply location, conductor size, and rating.

10) Inspect accessible network cabling for adherence to specified installation practices:

a) Cable installed in conduit or protective raceway.

b) Cable proximity to high voltage wiring.

c) Exposure to extreme temperatures, shock, vibration, chemicals, or moisture.

d) Bend radius.

11) Inspect cable and conductor terminations for adherence to specified installation practices.

12) Check all accessible components for evidence of physical damage.

13) Check grounding techniques including ground conductor sizes and termination points.

14) Non-permissible cable length.

15) Wrong cable type.

16) Signal reflections.

5. Electrical tests:

a. Measure network resistance.

b. Measure network cable length.

c. Line analysis for the following conditions:

1) Short circuit between signal lines A and B.

2) Short circuit between signal lines A and B and the cable shield.

d. Shield continuity.

e. Cross-wired signals lines.

f. Terminator installed in wrong position.

g. Poor transmission or reception levels.

h. Non-permissible stub line.

6. Generate slave list.

7. Measure power supply voltage at active terminations.

8. Evaluation:

a. Confirm the network cable topology (length and configuration) does not exceed data rate limitations.

b. Confirm total stub length (if required by design) does not exceed data rate limitations.

c. Calculate spare trunk length for the specified data rate.

9. Operations qualifications and test procedures:

   a. Electrical tests:

      1) Examine the data traffic between the master and each slave device.

      2) Verify baud rate.

      3) Confirm signal level.

      4) Verify network cycle time.

      5) Generate “live” slave list.

      6) Verify and record scanner diagnostic data including node status and error codes.

      7) Monitor and capture network waveform.

10. Evaluation:

   a. Confirm all specified slave devices appear on the live list.

   b. Evaluate data traffic between master and each slave to confirm proper slave configuration and performance.

   c. Inspect waveform capture for evidence of excessive noise.

   d. Evaluate and report any failed or questionable network tests.

   e. Evaluate and report network error codes and related symptoms.

G. Ultrasonic and radar check out:

1. Check response under all operating conditions.

2. Track all responses through trend charts in the SCADA system.

3. Provide Echo Transmission and signal quality on all level transmitters including guided and unguided units.

   a. Provide printout of the actual transmission and all parameters.

H. Functional Loop and Plant Specific SCADA Testing

1. General: The CONTRACTOR shall provide the services of factory-trained and experienced field personnel to perform verification and functional loop testing as described below. The purpose of functional loop testing is to (1) verify field cabling and wiring; (2) to verify circuits are performing their intended function by testing individual instrument loops; and (3) to verify plant specific I/O to the SCADA System. These functional loops consist of the following types; analog, discrete, and control and logic system.

2. Three (3) months prior to testing the CONTRACTOR shall submit a functional loop test plan. The plan shall include the list loops to be tested and the type of test for each loop listed. A loop may have multiple type tests. List all tests individually.

3. The ENGINEER personnel will witness all functional loop testing. Each functional loop must be complete, including wiring labels, and be pre-tested by Instrumentation Supplier, before any witness testing presumes. If more

than three loops fail in a calendar day, the CONTRACTOR shall reschedule the ENGINEER for another day and testing for that day will be suspended. Partial loops will not be tested.

I. Loop check/validation:

1. Check all control loops under simulated operating conditions by causing a range of input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the SCADA system. Issue commands from the SCADA system and verify proper responses of field devices. Use actual process inputs wherever available.

2. Provide “end-to-end” tests:

   a. Test SCADA system inputs from field device to SCADA system operator workstations.

   b. Test SCADA system outputs from SCADA operator workstations to field devices and equipment.

   c. Observe and record responses at all intermediate devices.

   d. Test and record operator commands and signal readouts to each operator device where there is more than one operator interface point.

   e. For each signal, perform separate tests for SCADA computer screens, local operator interface (LOI) screens, and local control panels.

3. Retest any loop following any necessary corrections.

4. Apply simulated sensor inputs corresponding to 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span for networks that incorporate analog elements, and monitor the resulting outputs to verify compliance to accuracy tolerance requirements.

5. Apply continuously variable up and down analog inputs to verify the proper operation and setting of discrete devices (signal trips, etc.).

6. Apply provisional settings on controllers and alarm set points.

7. Record all analog loop test data on test forms.

8. Exercise each field device requiring an analog command signal, through the SCADA system. Vary, during the validation process, the output from the PLC SCADA system and measure the end device position, speed, etc. to confirm the proper operation of the device for the supplied analog signal. Manually set the output from the SCADA screen at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent and measure the response at the final device and at any intermediate devices.

9. Exercise each field device providing a discrete input to the SCADA system in the field and observe the proper operation shall be observed at the operator workstation:

   a. Test limit switches, set limits mechanically, and observe proper operation at the operator workstation.

b. Exercise starters, relay contacts, switch contacts, and observe proper operation.

c. Calibrate and test instruments supplying discrete inputs, and observe proper operation.

10. Test each device accepting a discrete output signal from the SCADA. Perform the appropriate operator action at the SCADA operator stations (including LOIs, if present) and confirm the proper operation of the field device:

a. Stroke valves through outputs from the SCADA system, and confirm proper directional operation. Confirm travel limits and any feedback signals to the SCADA system.

b. Exercise motors starters from the SCADA system and verify proper operation through direct field observation.

c. Exercise solenoids and other field devices from the SCADA system and verify proper operation through direct field observation.

11. Include in the test forms:

a. Analog input devices:

1) Calibration range.

2) Calibration data: Input, output, and error at each test value.

3) Analog input associated PLC register address.

4) Value in PLC register at each test point.

5) Value displayed at each operator interface station (local operator interface displays and SCADA workstations).

b. Analog output devices:

1) Calibration range.

2) Test value at each test point.

3) Analog output associated PLC register address.

4) Control variable value at field device at each test point.

5) Physical device response at each test point:

a) Response to be actual valve position, or motor speed, etc.

c. Discrete instrument input devices:

1) Switch setting, contact action, and dead band.

2) Valve position switches:

a) Response in the PLC as the valve is stroked from the PLC.

b) Field observed actual valve position, and valve indicator position as the valve is stroked from the PLC.

3) Operator interface switches (control stations and other pilot devices) and associated response.

4) Starter and drive auxiliary device contact response.

5) Response of all other discrete inputs to the PLC.

d. Discrete output devices:

1) Observed response of field device to the discrete output from the PLC.

2) Observe the proper operation of Open, Close, Start, Stop, On, Off, etc.

e. Test equipment used and associated serial numbers.

J. Pre-commissioning (functional) test:

1. General:

a. Commence pre-commissioning tests after completion of all loop check/validation tests:

b. As specified in Section 17050, Sequencing and Scheduling article.

c. Pre-commissioning to demonstrate proper operation of all systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.

d. Pre-commissioning testing to generally occur in conjunction with functional testing specified in Section 01750.

e. Additional tests are specified in other Instrumentation and Control Sections.

f. Follow approved detailed test procedures and check lists for all pre-commissioning and test activities.

2. Control logic operational validation:

a. The purpose of control logic validation is to field test the operation of the complete control system, including all parts of the SCADA system, all control panels (including vendor control panels), all control circuits, all control stations, all monitored/controlled equipment, and final control elements.

b. Demonstrate all control functionality shown on the P&IDs, control schematics, and other drawings, and specified in the loop descriptions, control strategies, Electrical Specifications, and Mechanical Equipment Specifications.

c. Test in detail on a function-by-function and sentence-by-sentence basis.

d. Thoroughly test all hardware and software functions:

1) Including all hardwired and software control circuit interlocks and alarms.

e. Test final control elements, controlled equipment, control panels, and ancillary equipment under startup, shut down, and steady-state operating conditions to verify all logic and control is achieved.

f. Control logic validation tests to include, but not limited to: a repeat of all control logic tests from the factory acceptance tests, modified and expanded to include all field instruments, control panels, circuits, and equipment.

3. Loop tuning:

a. Optimally tune all electronic control stations and software control logic incorporating proportional, integral, or derivative control. Apply control signal disturbances at various process variable levels and adjusting the gain, reset, or rate settings as required to achieve proper response.

b. Verify the transient stability of final control elements operating over the full range of operating conditions, by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates. As a minimum, achieve 1/4 wave amplitude decay ratio damping (subsidence ratio of 4) under the full range of operating conditions.

c. If excessive oscillations or system instability occur, as determined by the ENGINEER, continue tuning and parameter adjustments, or develop and implement any additional control algorithms needed to achieve satisfactory control loop operation.

4. Pre-commissioning validation sheets:

a. Document each pre-commissioning test on an approved test form.

b. Document loop tuning with a report for each loop, including two-pen chart recordings showing the responses to step disturbance at a minimum of 3 setpoints or process rates approved by the ENGINEER. Show tuning parameters on the charts, along with time, date, and sign-off by CONTRACTOR and ENGINEER.

c. Include on the form, functions which can be demonstrated on a loop-by-loop basis:

1) Loop number and P&ID number.

2) Loop description or reference to specification tested.

3) Test procedures: Where applicable, use the FAT function-by-function, sentence-by-sentence loop test checklist forms modified to meet the requirements of the pre-commissioning test. Otherwise, create new forms.

d. For functions that cannot be demonstrated on a loop-by-loop basis (such as overall plant power failure), include on the test form a listing of the specific steps and tests to be conducted. Include with each test description the following information:

1) Specification page and paragraph of function demonstrated.

2) Description of function and/or text from specification.

3) Test procedures: use the FAT loop test checklist forms modified to meet the specific testing conditions of the pre-commissioning test.

5. Pre-commissioning certification:

a. Document via a certified report the completion of all pre-commissioning and test activities:

1) Including all test forms with test data entered, submitted to the ENGINEER with a clear and unequivocal statement that all pre-commissioning test requirements have been satisfied.

3.03 DEMONSTRATION AND TRAINING

A. Performance/reliability/operational tests:

1. After successful completion of the pre-commissioning test as accepted by the ENGINEER and OWNER, the performance test can proceed.

2. Complete training and instruction of the OWNER's personnel as specified in the Sequencing and Scheduling article of Section 17050.

B. The performance test may be performed concurrently with the 7-day operational test specified in Section 01750.

C. General:

1. The performance test is part of the Work that must be completed as a condition of substantial completion for the entire Project.

2. The complete PLC control and SCADA system must run continuously for the duration of the performance test. During this period, exercise all system functions, and log for cause of failure, any system interruption and accompanying component, subsystem, or program failure:

a. Include time of occurrence and duration of each failure.

3. Provide a competently trained technician or programmer on call for the Project Site during all normal working days and hours from the start of the performance test until final acceptance of the system. Response time to the Project Site:

a. 24 hours or less, for a major failure.

4. The performance test duration:

a. 7 days.

5. Test and use the entire process control system under standard operating conditions.

D. SCADA system testing:

1. Exercise each system function, e.g., status report, alarms, logs, and displays several times at a minimum, and in a manner that approximates "normal" system operation.

2. Failure of the SCADA system during testing shall be considered as indicating that the programs and operating system do not meet the requirements of the specifications.

   a. Corrective action is required before restarting the acceptance test.

E. Failures:

1. Classify failures as either major or minor.

   a. Minor failure:

      1) A small and non-critical component failure or software problem that can be corrected by the OWNER's operators.

      2) Log this occurrence but this is not a reason for stopping the test and is not grounds for non-acceptance.

      3) Should the same or similar component failure occur repeatedly, this may be considered as grounds for non-acceptance.

      4) Failure of one printer or operator station is considered a minor failure providing all functions can be provided by backup equipment, i.e., alternate printers and operator station, and repairs can be made and equipment returned to service within 3 working days.

   b. Major failure:

      1) Considered to have occurred when a component, subsystem, software control, or program fault causes a halt in or improper operation of the system and/or when a technician's work is required to make a repair or to re-initiate operation of the system.

      2) Cause termination of the performance test.

      3) Start a new acceptance test when the causes of a major failure have been corrected.

      4) A failure is also considered major when failure of any control system that results in an overflow, underflow, overdose, or underdose condition occurs.

F. Technician report:

1. Each time a technician is required to respond to a system malfunction, he or she must complete a report, which includes details concerning the nature of the complaint or malfunction and the resulting repair action required and taken.

2. If a malfunction occurs which clears itself or which the operator on duty is able to correct, no report is required or logged as specified above.

3. If a technician has performed work but no report is written, then a major failure is considered to have occurred.

4. Each report shall be submitted within 24 hours to the ENGINEER and the OWNER, or its representative.

3.04 SCHEDULES

A. Example test forms:

1. Example test forms are attached at the end of this Section. They may be used as a starting point for the development of Project-specific test forms for this Project.

2. The example test forms are not intended to be complete or comprehensive. Edit and supplement the forms to meet the requirements for testing and test forms specified in this Section and other Contract Documents.

END OF SECTION

BILL OF MATERIAL

PROJECT: _____ DATE / /

LOCATION: _____ PAGE _____

SPECIFICATION SECTION	QTY	DESCRIPTION	MFG.	PART NUMBER	TAG No.

SCHEDULED TEST REQUEST FORM

COMPANY PERFORMING TEST: _____
TESTING PERSONNEL : _____ _____
PHONE NUMBER OF COMPANY: _____
TEST PROCEDURE SUBMITTAL: _____ APPROVED : ___/___/___
SCHEDULED TEST DATE : _____ DATE : ___/___/___

TIME	DESCRIPTION OF TEST
8:00	
9:00	
10:00	
11:00	
12:00	
13:00	
14:00	
15:00	
16:00	

NOTES:

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

POWER AND CONTROL CONDUCTOR TEST FORM

TEST FORM (TF1)

EQUIPMENT
NAME : _____ LOCATION : _____

CONDUCTOR NUMBER	INSULATION TESTS					
	PHASE TO GROUND			PHASE TO PHASE		
	A	B	C	AB	BC	CA

NOTES:
Record insulation test values in meg-ohms.

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

INSTRUMENTATION CONDUCTOR TEST FORM

TEST FORM (TF2)

EQUIPMENT

NAME : _____ LOCATION : _____

CONDUCTOR PAIR NUMBER	CONTINUITY TESTS		INSULATION TESTS		
	CONDUCTOR TO CONDUCTOR	CONDUCTOR TO SHIELD	CONDUCTOR TO CONDUCTOR	CONDUCTORS TO GROUND*	SHIELD TO GROUND

NOTES:

Record continuity test values in ohms.

record insulation test values in meg-ohms.

* With both conductors tied together

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

GROUNDING SYSTEM TEST FORM

TEST FORM (TF3)

FALL IN POTENTIAL TEST

MAIN GROUND LOCATION	APPLIED VOLTAGE V	MEASURED POINT 1 VOLTAGE	MEASURED POINT 2 VOLTAGE	MEASURED POINT 3 VOLTAGE	CALCULATED RESISTANCE OHMS

TWO POINTS TESTS

EQUIPMENT NAME	EQUIPMENT #	CIRCUIT #	APPLIED CURRENT	MEASURED VOLTAGE	CALCULATED RESISTANCE OHMS

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

VISUAL AND MECHANICAL INSPECTION FORM

TEST FORM (TF4)

EQUIPMENT

NAME : _____ LOCATION : _____

NAMEPLATE DATA

MFGR. :	_____	SERIES # :	_____
MODEL # :	_____	U.L. # :	_____
VOLTAGE :	_____	PHASE :	_____
AMPERAGE :	_____	SERVICE :	_____
BUS TYPE :	_____	BUS BRACING:	_____
VERT. BUS :	_____	HORZ. BUS :	_____
GND. BUS :	_____	NEU. BUS :	_____
ENCLOSURE :	_____		_____
	_____		_____

INSPECTION CHECK LIST

ENTER: A-ACCEPTABLE R-NEEDS REPAIR OR REPLACEMENT NA-NOT APPLICABLE

TIGHTEN ALL BOLTS AND SCREWS	_____
TIGHTEN ALL WIRING AND BUS CONNECTIONS	_____
VERIFY ALL BREAKERS AND FUSES HAVE PROPER RATING	_____
CHECK BUS BRACING AND CLEARANCE	_____
CHECK MAIN GROUNDING CONNECTION AND SIZE	_____
INSPECT GROUND BUS BONDING	_____
CHECK EQUIPMENT GROUNDS	_____
CHECK CONDUIT GROUNDS AND BUSHINGS	_____
INSPECT NEUTRAL BUS AND CONNECTIONS	_____
CHECK HEATERS AND THERMOSTATS	_____
CHECK VENTILATION AND FILTERS	_____
CHECK FOR BROKEN OR DAMAGED DEVICES	_____
CHECK DOOR AND PANEL ALIGNMENT	_____
INSPECT ANCHORAGE	_____
CHECK FOR PROPER CLEARANCES AND WORKING SPACE	_____
REMOVE ALL DIRT AND DUST ACCUMULATION	_____
INSPECT ALL PAINT SURFACES	_____
CHECK FOR PROPER WIRE COLOR CODES	_____
INSPECT ALL WIRING FOR WIRE LABELS	_____
CHECK FOR PROPER WIRE TERMINATIONS	_____
CHECK FOR PROPER WIRE SIZES	_____
INSPECT ALL DEVICES FOR NAMEPLATES	_____
CHECK IF DRAWINGS MATCH EQUIPMENT	_____
CHECK ACCURACY OF OPERATION & MAINTENANCE	_____
	_____

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

PANEL-BOARD TEST FORM

TEST FORM (TF5)

PANEL NAME: _____ LOCATION : _____

NAMEPLATE DATA

MFGR. :	_____	SERIES # :	_____
MODEL # :	_____	U.L. # :	_____
VOLTAGE :	_____	PHASE :	_____
AMPERAGE :	_____	SERVICE :	_____
BUS TYPE :	_____	BUS BRACING:	_____
VERT. BUS :	_____	HORZ. BUS :	_____
GND. BUS :	_____	NEU. BUS :	_____
ENCLOSURE :	_____	MAIN BKR :	_____

INSULATION RESISTANCE TESTS - MEGOHMS					
A-GND	B-GND	C-GND			

INSPECTION CHECK LIST

ENTER: A-ACCEPTABLE R-NEEDS REPAIR OR REPLACEMENT NA-NOT APPLICABLE

TIGHTEN ALL BOLTS AND SCREWS	_____
TIGHTEN ALL WIRING AND BUS CONNECTIONS	_____
VERIFY ALL BREAKERS AND FUSES HAVE PROPER RATING	_____
CHECK BUS BRACING AND CLEARANCE	_____
CHECK MAIN GROUNDING CONNECTION AND SIZE	_____
INSPECT GROUND BUS BONDING	_____
CHECK EQUIPMENT GROUNDS	_____
CHECK CONDUIT GROUNDS AND BUSHINGS	_____
INSPECT NEUTRAL BUS AND CONNECTIONS	_____
CHECK FOR BROKEN OR DAMAGED DEVICES	_____
CHECK DOOR AND PANEL ALIGNMENT	_____
INSPECT ANCHORAGE	_____
CHECK FOR PROPER CLEARANCES AND WORKING SPACE	_____
REMOVE ALL DIRT AND DUST ACCUMULATION	_____
INSPECT ALL PAINT SURFACES	_____
CHECK FOR PROPER WIRE COLOR CODES	_____
INSPECT ALL WIRING FOR WIRE LABELS	_____
CHECK FOR PROPER WIRE TERMINATIONS	_____
CHECK FOR PROPER WIRE SIZES	_____
INSPECT ALL DEVICES FOR PROPER LEGEND NAMEPLATES	_____
	_____

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

OPERATIONAL DEVICE CHECKS AND TESTS FORM

TEST FORM (TF6)

NAME : _____ LOCATION : _____

CUB. #	EQUIPMENT NAME	EQUIP #	LOCAL SITE DEVICE CHECKS AND TESTS							REMOTE SITE DEVICE CHECKS & TESTS		
			SELECTOR SWITCH	INDICATOR LIGHTS	PUSHBUTTON & LOS	METERING & INDICATORS	OVERLOAD RESET	INTERLOCKS & CONTROL	ALARM & STATUS	SELECTOR SWITCH	INDICATOR LIGHTS	PUSHBUTTON & LOS

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY : _____

NOTES:

PHASE ROTATION TEST FORM

TEST FORM (TF7)

EQUIPMENT NAME	EQUIPMENT #	CIRCUIT #	PHYSICAL PHASE LOCATION	PHASE COLOR CODE	MEASURED PHASE ROTATION

NOTES:
Use phase tester to verify all circuits and equipment have a clockwise A-B-C phase rotation.
Physical phase locations: Left to Right - LR or Top to Bottom - TB
Phase color codes: Brown, Orange, & Yellow -BOY
Black, Red, & Blue -BkRBe

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

MCC DEVICE TEST FORM

TEST FORM (TF8)

MCC # : _____ CUBICLE : _____

EQUIP NAME: _____ EQUIP # : _____

MOTOR DATA	CONTACTOR DATA	
H.P. : _____	MFGR. : _____	PART # : _____
F.L.A. : _____	NEMA SIZE : _____	COIL VOLT : _____

OVERLOAD TESTS

MFGR. : _____ HEATER # : _____ RANGE : _____

PART # : _____ FINAL OVERLOAD SETTING: _____

TEST AMPS	MEASURE TRIP TIME @ TEST AMPS			MFGR LISTED TRIP TIME	AMBIENT COMPENSATION
	PHASE A	PHASE B	PHASE C		

BREAKER TESTS

MRGR. : _____ PART # : _____ FRAME # : _____

CONTACT RESISTANCE TESTS - OHMS			INSULATION RESISTANCE TESTS-MEGOHMS		
PHASE A	PHASE B	PHASE C	A-GND	B-GND	C-GND

MFGR TRIP TIME @300% MIN:_____ BREAKER RATING / RANGE: _____

MFGR TRIP TIME @300% MAX:_____ FINAL BREAKER SETTING: _____

MFGR INST. PICKUP AMPS: _____

TIME-CURRENT TEST					
TRIP TIME IN SECONDS @ 300% AMPS			INSTANTANEOUS TRIP TEST - AMPS		
PHASE A	PHASE B	PHASE C	PHASE A	PHASE B	PHASE C

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

BREAKER DEVICE TEST FORM

TEST FORM (TF9)

FEEDER : _____ LOCATION : _____
EQUIP NAME: _____ EQUIP # : _____
EQUIP H.P. : _____ EQUIP KVA : _____

MFGR. : _____ PART # : _____ FRAME # : _____
VOLTAGE : _____ INTERRUPT RATING : _____ CHARACTER: CURVE _____

CONTACT RESISTANCE TESTS - OHMS			INSULATION RESISTANCE TESTS - MEGOHMS		
PHASE A	PHASE B	PHASE C	A-GND	B-GND	C-GND

MFGR TRIP TIME @300% MIN : _____
MFGR TRIP TIME @300% MAX: _____

BREAKER RATING / RANGE: _____
FINAL BREAKER SETTING : _____
MFGR INST. PICKUP AMPS: _____

TEST-CURRENT TESTS TRIP TIME IN SECONDS @ 300% AMPS			INSTANTANEOUS TRIP TEST - AMPS		
PHASE A	PHASE B	PHASE C	PHASE A	PHASE B	PHASE C

ADDITIONAL TESTS AND SETTING AS APPLICABLE

FUNCTION	PICKUP		DELAY-TIME		
	RANGE	SETTING	RANGE	SETTING	
LONG TIME					
SHORT TIME					
GROUND FLT.					

NOTES:

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

MOTOR TEST FORM

TEST FORM (TF10)

EQUIPMENT
NUMBER : _____ NAME : _____

NAMEPLATE DATA - FIELD RECORDED

MANUFACTURER		MODEL #		SERIAL #		FRAME #	
H.P.	R.P.M	F.L.A	VOLTS	PHASE	FREQ.	P.F.	S.F.
CODE	N.E.M.A.	INSUL.	ENCLOSR.	DUTY	DESIGN		

INSULATION TESTS PHASE TO GROUND MEG-OHMS			MOTOR FRAME GROUNDING SYSTEM TEST			MOTOR HEATER MEAS. AMPS	MOTOR THERMAL TRIP TEST
A	B	C	APPLIED VOLTS	MEAS. AMPS	CALC. OHMS		

MOTOR TESTS - MEASURED VALUES

AMPERAGE			VOLTAGE			POWER FACTOR	WATTAGE
A	B	C	AB	BC	CA		

NOTES:
VOLTAGE, AMPERAGE, POWER FACTOR, & WATTAGE SHALL BE RECORDED WITH A TRUE RMS METER.

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

FACTORY TEST
MCC/CONTROL PANEL CHECKOUT FORM (TF11)

Manufacturer: _____ **Location:** _____

Job No.: _____

Tel: _____ **Fax:** _____

MCC / Control Panel: _____ **TEST RESULT**

OVERALL PANEL INSPECTION	**Pass**	**Fail**
1. All front panel and back panel components mounted securely.....	☐	☐
2. All wiring terminated and labeled correctly.....	☐	☐
3. All components, wiring, and labeling accurately reflected on the drawings..	☐	☐
POWER-UP INSPECTION		
1. Voltage levels on load side of circuit breakers.....	☐	☐
2. Voltage levels at the DC terminals of the power supply.....	☐	☐
3. Voltage levels at the DC power distribution terminals.....	☐	☐
POWER DISTRIBUTION AND GENERAL COMPONENT TESTING		
1. Power distribution to the appropriate components.....	☐	☐
2. Operation of the ancillary components such as receptacles, work lights, etc.	☐	☐
CONTROL COMPONENTS CHECKS		
1. Operators (push buttons, selector switches, pilot lights).....	☐	☐
2. Inputs from External Sources.....	☐	☐
3. Outputs to External Sources.....	☐	☐
4. Relay Logic.....	☐	☐
5. PLC I/O and Program Verification.....	☐	☐
6. O/I Display Verification.....	☐	☐

Notes:

1. For relay logic checks, each rung of the elementary or loop diagram is to be highlighted in yellow as they are verified for correct control functions.
2. For PLC I/O and program verification, the control strategies shall be highlighted in yellow as each logic function is tested.

Tested by: _____ **Witnessed by:** _____

Date: _____

HARMONIC MEASUREMENTS

TEST FORM (TF12)

PUMP # ____ RUNNING

VFD SPEED	100%	90%	80%	70%	60%	50%
TIME						
AVG. VOLTS						
TOTAL AMPS						
TOTAL KW						
TOTAL KVA						
TOTAL KVAR						
PF						
dP						
VOLTAGE THD						
AMPS THD						
5th						
7th						
11th						
13th						

PUMP # ____ RUNNING

VFD SPEED	100%	90%	80%	70%	60%	50%
TIME						
AVG. VOLTS						
TOTAL AMPS						
TOTAL KW						
TOTAL KVA						
TOTAL KVAR						
PF						
dP						
VOLTAGE THD						
AMPS THD						
5th						
7th						
11th						
13th						

I/O POINT CHECKOUT TEST FORM

TEST FORM (TF13)

I/O TYPE : _____ LOCATION : _____

I/O POINT TAGNAME	I/O POINT ADDRESS	TEST INPUT VALUE %			DISPLAY VALUE %			PLC REGISTER VALUE	TEST RESULT FAIL OR PASS COMMENTS	DATE OF CORRECTIVE ACTION
		0	50	100	0	50	100			

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

INSTRUMENTATION DATA SHEET AND CALIBRATION RECORD TEST FORM (TF14)

Component Description	Manufacturer	Location
	Name	Site
Component Tag Name	Model	Equip
	Serial #	

	Range	Unit
Indicator Range		
Input Range		
Output Range		

General Notes

1) Attach Calibration Curves for dp Flowmeters
2) Include mounting elevations for level Instruments
3) All entries within solid box to be typed in prior to start of test

Designed Calibration			Measured Calibration		
Input Signal	Output	Eng. Value	Input	Output	Comments

Notes _____

Tested by (Print Name) _____ Witnessed by (Print Name) _____

Signature _____ Signature _____

Date / / Date / /

VFD OR SOFT STARTER PROGRAM PARAMETER RECORD SHEET

TEST FORM (TF16)

EQUIPMENT

NAME : _____ LOCATION : _____

PARAMETER NUMBER	PARAMETER DESCRIPTION	DEFAULT SETTING	FIELD SETTING

NOTES:

TESTED BY : _____ DATE : ____/____/____

WITNESSED BY: _____

RADIO TEST REPORT

TEST FORM (TF17)

RADIO FREQUENCY : _____ RADIO MANUFACTURER : _____
RADIO MODEL # : _____ SERIAL # : _____
LOCATION : _____

PARAMETER	INITIAL VALUE	FINAL VALUE
CHANNEL/HOP PATTERN		
SYSTEM ADDRESS		
OPERATING MODE		
DATA RATE		
BUFFER		
CTS TIMER		
TIME-OUT TIMER		
LOOPBACK CODE		
SOFTWARE REVISION		
HOPPER BOARD REVISION		
FREQUENCY LOCKOUTS		
DC VOLTAGE WHEN TRANSMITTING		
RADIO POWER OUTPUT (WATTS)		
MATCH EFFICIENCIES		
RETURN LOSS		
ANTENNA VSWR (REFLECTED POWER)		
EFFECTIVE ISOTROPIC RADIATED POWER (EIRP)		

NOTES: CHECK OUT ALL COMPONENTS FOR PROPER GROUNDING.

TESTED BY : _____ DATE : ____/____/____
WITNESSED BY: _____

APPENDIX A

RMA Group, Inc., *Geotechnical Report, Shasta Park Water Reservoir*.
January 25, 2016.

GEOTECHNICAL REPORT

SHASTA PARK WATER RESERVOIR

CITY OF SACRAMENTO
DEPARTMENT OF UTILITIES

City of Sacramento
Department of Utilities
1395 35th Avenue
Sacramento, CA 95822

March 29, 2013

Project No. Z14005400
March 29, 2013

Mr. Brett Ewart
City of Sacramento, Department of Utilities
Engineering Services Division
1395 35th Avenue
Sacramento, CA 95822

Subject: **GEOTECHNICAL REPORT**
SHASTA PARK WATER RESERVOIR
SACRAMENTO, CALIFORNIA

Dear Mr. Ewart:

The accompanying report presents the results of our geotechnical services performed for a proposed water reservoir facility to be located adjacent to Shasta Park in Sacramento, California. The report includes background information regarding the anticipated construction, the purpose of our services, and scope of services provided. In addition, discussions regarding our investigative procedures, the site conditions encountered during our field exploration, and the geologic/seismic conditions in the project area are presented. Finally, geotechnical conclusions and recommendations are provided for project design and construction. The appendices of the report includes logs of borings, the results of laboratory tests, and a site specific seismic design criteria study completed by the RMA Group.

I appreciate the opportunity to provide geotechnical services for this project. If you have questions regarding this report or if I may be of further assistance, please feel free to contact me.

Respectfully submitted,

REGISTERED PROFESSIONAL ENGINEER
GARY H. GULSETH
No. 2283
GEOTECHNICAL
STATE OF CALIFORNIA

Gary H. Gulseth, G.E.
Department of Utilities
Engineering Services

4c: Client

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PLATE NO. 1 - VICINITY/BORING LOCATION MAP

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APPENDIX B - RESULTS OF LABORATORY TESTING
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GEOTECHNICAL REPORT
SHASTA PARK WATER RESERVOIR
SACRAMENTO, CALIFORNIA

1.0 INTRODUCTION

This report presents the results of our geotechnical services performed for a proposed 4 million gallon water reservoir facility to be located adjacent to Shasta Park in Sacramento, California. The site location relative to existing streets is shown on Plate 1.

Design of the proposed facility was underway at the time this report was prepared. As a result, final grading and structural criteria were unavailable. On a preliminary basis, the proposed facility will include a 163 foot diameter water storage tank, a groundwater treatment building, an electrical building, a 100,000 gallon backwash recycle tank, a booster station, and a horizontal filter all surrounded by asphalt and/or concrete paving.

The proposed wire-wrapped, prestressed concrete water storage tank will be about 30 feet high and partially buried about 10 below existing site grade. A structural slab foundation or a six inch thick concrete “membrane” slab with a 5 to 6 foot wide circumferential footing will be utilized for support of the tank. We anticipate that 30 to 35 interior columns spaced laterally about 20 to 25 feet apart will support a majority of the roof load. We anticipate the proposed steel backwash recycle tank will be about 35 feet in diameter and 16 feet tall, supported by a reinforced concrete slab or ring-wall foundation.

The proposed treatment and electrical buildings are anticipated to be small single-story, masonry structures with conventional spread foundations and concrete floor slabs. We anticipate the proposed booster station and horizontal filter equipment will be supported on lightly loaded concrete equipment pads.

Traffic within the facility should consist primarily of light, two axle, four tire vehicles with an occasional moderately heavy, three axle service truck or crane. The facility will be enclosed by a wrought iron fence with wrought iron gates. Access to the facility will be provided from Kastanis Way. A new transmission main will be placed along Imagination Parkway between the storage reservoir and an existing 24 inch main in Bruceville Boulevard.

Since the lot appears to be relatively level, cuts and fills during earthwork are anticipated to be minimal (1 foot or less in vertical extent) and limited to providing level structure pads and positive site drainage. Excavations for on-site utilities and the proposed new transmission main are not anticipated to exceed 10 feet below final site grade.

A plot plan showing the proposed project layout is also presented on Plate 1. In the event these details are inconsistent with the final design criteria, we should be contacted prior to final design in order that we may update the recommendations as needed.

2.0 PURPOSE AND SCOPE OF SERVICES

The purpose of our services was to explore and evaluate the subsurface conditions at various locations on the site in order to develop recommendations related to the geotechnical aspects of project design and construction.

The scope of our services included the following:

- A visual site reconnaissance to investigate the surface conditions at the project site
- A field investigation that consisted of drilling borings within the area of the proposed water tank and water transmission main to explore the subsurface conditions at the project site
- Laboratory testing of representative samples obtained during the field investigation to evaluate relevant physical and engineering parameters of the subsurface soils
- A review of available publications and maps regarding the known geologic conditions in the project area
- Contracting with the RMA Group to provide site specific seismic design criteria for design of the proposed project
- Evaluation of the data obtained and an engineering analysis to develop the geotechnical conclusions and recommendations
- Preparation of this report which includes:
  - A description of the proposed project
  - A description of the field and laboratory investigations
  - A description of the surface and subsurface conditions encountered during our field investigation
  - A summary of the geologic and seismic conditions within the project area
  - Conclusions and recommendations related to the geotechnical aspects of the project design and construction
  - A vicinity map/boring location plan, and
  - Appendices that includes boring logs, a summary of laboratory tests, and the site specific seismic design criteria report prepared by the RMA Group.

3.0 FIELD AND LABORATORY INVESTIGATIONS

Field Investigation

The subsurface conditions at the site were explored on January 26 and 27, 2012 by drilling five borings within two proposed overlapping storage tank locations to depths ranging from about 30 to 70 feet below existing grade. Two additional borings were drilled adjacent to the proposed water main alignment to depths of about 10 feet below existing site grade. The borings were drilled by the Precision Sampling using a CME-75 truck-mounted drill rig equipped with 6 inch O.D. hollow-stem auger. Following our explorations the layout for the proposed facility was revised. The approximate boring locations with relation to the revised facility layout are presented on Plate 1.

During the drilling operations, penetration tests were performed in accordance with ASTM D-1586 at regular intervals using either a Modified California Sampler or a Standard Penetration Sampler to evaluate the relative density of coarse-grained (cohesionless) soil and to retain soil samples for laboratory testing. The consistency of fine-grained (cohesive) soil was determined using a pocket penetrometer. The penetration tests were performed by initially driving the sampler 6 inches into the bottom of the bore hole using a 140 pound automatic hammer falling 30 inches to penetrate loose soil cuttings and “seat” the sampler. Thereafter, the sampler was progressively driven an additional 12 inches, with the results recorded as the corresponding number of blows required to advance the sampler 12 inches, or any part thereof. A representative with the RMA Group maintained a log of the borings and visually classified the soils encountered according to the ASTM D2487 and the Unified Soil Classification System. Soil samples obtained from the borings were packaged and sealed in the field to reduce moisture loss and disturbance and submitted to the RMA Group for testing. The boring logs are presented in the Appendix A.

The borings were located in the field by visual sighting and/or pacing from existing site features; therefore, the locations shown on Plate 1 should be considered approximate. The penetration resistance (Blows Count) shown on the boring logs represents field penetration that has not been corrected for overburden pressure, sampler size, hammer type, borehole diameter, rod length, sampling method or any other correction factor.

Laboratory Investigation

Laboratory tests were performed in accordance with current ASTM standards on selected soil samples to evaluate their physical characteristics and engineering properties. The laboratory testing program was formulated with emphasis on the

evaluation of natural moisture content, in-place density, percent passing the #200 sieve, plasticity, unconfined compression strength, and consolidation characteristics of the materials encountered. In addition, pH, minimum resistivity, sulfate concentration and chloride concentration tests were performed on near-surface soil samples to evaluate the general corrosivity of the soils to buried concrete and ferrous metals. A Resistance Value (R-value) tests was performed on a representative bulk sample of the near-surface soils.

The results of laboratory tests are summarized in the Appendix B. This information, along with the field observations, was used to prepare the final boring logs.

4.0 SITE CONDITIONS

Surface Conditions

At the time of our field explorations, the project site is bound to the north by the cul-de-sac for Kastanis Way and vacant property, to the south by Shasta Park and the Shasta Park library, to the east by several homes and the terminus of Cotton Lane, and directly to the west by vacant property and Bruceville Boulevard beyond. At the time of our field investigation, the 1.8 acre, rectangular site was vacant, relatively level and covered by plowed soil and sparse vegetation.

Subsurface Conditions

The subsurface soils encountered varied somewhat between boring locations. In general, the upper soils consisted of highly plastic Fat Clay with Sand (CH) to depths ranging from about 2½ to 4 feet below site grade, followed by medium plastic Lean Clay with Sand (CL) to depths of about 4½ to 16½ feet. The clays were underlain by low to non-plastic Silty Sand (SM) and Sandy Silt (ML) to depths of about 15 to 19 feet. These soils were followed by interbedded strata of moderately plastic Lean Clays (CL) and low plastic Lean Silt (ML) to a depth of about 44 feet. Finally, these soils were underlain by Silty Sand (SM) and poorly graded “clean” sand (SP) to a depth of about 70 feet, the maximum depth explored.

The consistency of the silt and clay was predominately hard, while the relatively density of the sand ranged from medium dense to very dense. An isolated stratum of loose silty sand was encountered at a depth of about 50 feet. Based on previous experience, this silty sand was likely disturbed by the drilling operation and the penetration result is likely not representative of actual conditions.

The moisture condition of the clay and silt soil samples retained ranged from moist (moisture content estimated to be near standard proctor optimum) to very moist (moisture content estimated to be several percentage points above standard proctor optimum). The moisture condition of the upper sands ranged from slightly moist or damp (moisture content estimated to be below standard proctor optimum) to moist. The lower sands were very moist to wet (moisture content at or near saturation)

The test borings were checked for the presence of groundwater during and immediately following drilling operations. Groundwater was measured in Boring B-1 at a depth of about 48 feet below site grade. Groundwater or seepage was not encountered in the remaining borings. Groundwater elevations and soil moisture conditions within the project area will vary depending on seasonal rainfall, irrigation practices, land use, and/or runoff conditions not apparent at the time of our field

investigation. The evaluation of such factors is beyond the scope of this investigation. However, groundwater contour maps maintained by the California Department of Water Resources (Spring 1979 to Spring 2007) using data compiled from water-wells show a high groundwater level in the project area at a elevation about -20 to -30 feet, or about 48 to 58 feet below the existing site grade.

Detailed descriptions of the subsurface conditions encountered during the field investigation are presented on the boring logs in the Appendix A.

5.0 GEOLOGIC CONDITIONS

Geologic Setting

The project site is located in the southeast portion of Sacramento, which in turn is located in the south-eastern portion of the Sacramento Valley. Physiographically, the project site is located along the eastern margin of the Central Valley, which encompasses the San Joaquin and Sacramento Valleys and is generally bounded by the Sierra Nevada Mountains to the east, the Coast Ranges to the west, the Mojave Desert and Transverse Ranges to the south, and the Klamath Mountains to the north. The Sacramento Valley extends roughly from the Stockton-Tracy area on the south to the Klamath Mountains on the north. The Central Valley is a large northwestward-trending, asymmetric structural trough with a long, gently sloping eastern shelf underlain by the subsurface extension of the Sierran granitic rocks and a shorter more steeply sloping western margin where the basin sediments have been upturned and dip eastward back toward the valley axis. The Central Valley has been filled with more than 30,000 feet of sediment in the San Joaquin Valley and more than 50,000 feet of sediment in the Sacramento Valley (Bertoldi and others, 1991; Harwood and Helley, 1987) derived primarily from erosion of the adjacent Sierra Nevada and Coast Range Mountains. The sediment ranges in age from the Jurassic to recent (approximately 210 to 1.6 million years old) while bedrock underlying the sediment are predominantly marine deposits of siltstone, claystone and sandstone.

East of the Sacramento River, much of Sacramento Valley, including the project site, is underlain by large broad alluvial fans of Pleistocene age (10,000 to 1.8 million year old) referred to as the Riverbank Formation. This formation is composed of semi-consolidated silt, clay, sand and gravel derived from the western slopes of the Sierra Nevada that buries Miocene to Eocene age (approximately 5 to 58 million year old) alluvial fans of the Turlock Lake, Laguna and Mehrten Formations (Dupras and others, 1988; Harwood and Helley, 1985). West of the project site, the Riverbank Formation is overlain by typically 5 to +50 feet of undifferentiated Holocene age (generally less than 10,000 years old) alluvial and basin deposits consisting of unconsolidated clay, silt, sand and gravel deposited by the current Sacramento and American river systems.

The Soil Survey of Sacramento County, California (1993) describes the near-surface soils as moderately well draining alluvium of the San Joaquin-Galt Complex (217). The soils are further described as low to moderately plastic silt and clays with a thin Interbedded claypan or hardpan layer within the upper 2 feet.

The native soils encountered in our exploratory borings appear consistent with this mapping.

Faulting and Seismicity

Compared with other portions of California, the Sacramento area has had moderately low seismic activity based on historical records. The San Andreas fault (SAF), located about 79 miles to the southwest, is considered to dominate the structure and seismicity of the region. To the west of the SAF is the Pacific plate which moves north relative to the North American plate located east of the fault. In the San Francisco Bay area, movement across this plate boundary is concentrated on the SAF; however, it is also distributed, to a lesser extent, across a number of faults which include the Calaveras, Concord-Green Valley, Greenville, Rodgers Creek, and Hayward faults among others. Together, these faults are referred to as the SAF system. Some significant events attributed to the SAF include the 1906 (M8+) San Francisco earthquake, the 1838 and 1865 (M7) San Francisco earthquakes, and the 1989 (M6.9) Loma Prieta earthquake. Seismic events attributed to some of the secondary faults located in the east San Francisco Bay area include the 1861 (M5.7) San Ramon Valley earthquake on the Calaveras fault, the 1980 (M5.8) Livermore earthquake on the Greenville fault, the 1889 (M6.3) Antioch earthquake, the 1955 (M5.4) Concord fault earthquake, and the 1868 (M6.8) Hayward fault earthquake.

In relatively recent studies of the Sacramento Delta region, a series of predominately blind thrust faulting, reverse faults and folds that extend for several hundred miles from the southern San Joaquin Valley northward to the northern Sacramento Valley have been used in seismic source characterization. This system is commonly referred to as the Great Valley fault system. The regional studies have suggested that the Great Valley fault system is comprised of between 18 and 25 segments ranging from 7 to 35 miles in length on the basis of the seismo-tectonic environment of the area. Fault segments with the closest approach to the project site are known at the Great Valley 2, 3, 4, 5 and 7 fault zones (Jennings and Bryant, 2010). The Great Valley 4 fault zone, about 22 to 30 miles northwest of the project site, is believed to be the source of the 1892 (M6.4) Winters-Vacaville earthquake (Toppozada, et. al, 1981). Other earthquakes attributed to the Great Valley fault system include the 1983 (M6.5) Coalinga earthquake and the 1985 (M6.1) Kettlemen Hills earthquake.

Several faults known collectively as the Foothills Fault System located about 28 miles east of the project site also have the potential to generate earthquakes and ground shaking at the site. This series of subparallel, northwest-trending vertical faults includes at least two major fault zones. The easternmost is the Melones Fault zone, and the westernmost is the Bear Mountains Fault zone. Typical recurrence intervals appear to be very long, from tens of thousands to more than a hundred thousand years. However, the occurrence of the 1975 (M5.7) Oroville earthquake is associated with the Foothills Fault System (Toppozada, et al., 1979). Located about 60 miles from the project site, the Oroville earthquake represents the first documented surface faulting in the western foothills of the Sierra Nevada.

In summary, the general project area is characterized by recurring seismic activity. During the design life of the proposed facility it is probable that at least one earthquake will cause moderate to strong ground shaking in the vicinity of the project. In comparison with other areas of California, however, the project area is seismically quiescent. No faults which displace valley alluvium are known to exist at or near the project site nor is the site within an Earthquake Fault Zone as defined by the Alquist-Priolo Earthquake Zoning Act of 1972.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 General

Based on the subsurface conditions encountered, it is our professional opinion that the site should be suitable from a geotechnical standpoint for support of the proposed water storage tank and other improvements provided the recommendations contained herein are incorporated into the project design.

The subsurface soils appear to consist of relatively stiff/dense clay, silt and sand that is moderately strong and low compressible with a low to negligible susceptibility to seismic liquefaction, dynamic settlement or ground rupture. The near-surface clay, however, can exhibit significant expansion or swelling characteristics with seasonal and man-made increases in soil moisture content. This expansive clay is common within the project area and poses a risk for post-construction heave and cracking of the concrete slabs, as well as lightly loaded foundations and pavement.

Specific geotechnical conclusions and recommendations addressing the subsurface conditions at the project site, along with the general aspects of design and construction, are presented in the following sections.

6.2 Tank Foundations

We anticipate the proposed water storage tank will be partially buried about 10 feet and may be supported by a structural slab foundation or a six inch thick concrete "membrane" slab with a 1½ foot thick, 5 to 6 foot wide circumferential footing. The concrete "membrane" slab will be reinforced to support interior columns and uniformly transmit loads to the subgrade materials. We anticipate the proposed steel backwash recycle tank will be supported by a structural slab or ring-wall foundation. The following presents recommendations for these foundation alternatives

Structural Slab Foundation

The proposed water storage tank and backwash recycle tank may be supported by a structural slab or mat foundation designed using allowable bearing pressures of 3,000 and 2,000 pounds per square foot (psf), respectively, for dead plus sustained live loading. Given these bearing pressures, total settlement should be on the order of 1 to 1½ inches. We estimate that about ¼ to ½ inch of settlement should occur during or soon after construction of the proposed tanks. The remaining settlement should occur once the proposed tanks are filled. The maximum differential settlement, assuming the structural slabs will be designed using the conventional rigid method, should be on

the order of about ½ inch edge to opposite edge. The allowable bearing pressures may be increased by one-third when considering short-term loading due to wind or seismic forces.

If the proposed structural slab foundations are designed based on approximate flexible methods (Winkler foundation), a k-value or coefficient of subgrade reaction (assuming a square plate measuring 1 foot by 1 foot) of 220 pounds per cubic inch (pci), a Young's modulus (E_s) of 350 kips per square foot (ksf), and a Poisson's ratio (μ_s) of 0.3 may be used for design based on the unsaturated subgrade soil conditions encountered at the site. The Young's Moduli was determined based on empirical correlations (Mitchell and Gardner, 1975), the Poisson's ratio was selected from published values, and the k-value was determined based on Vesic (1961). If the project would benefit from greater design values or if the structural slab foundations are critically sensitive to loading and deflection, field and/or laboratory tests should be performed to better define the subgrade parameters

Structural slab foundations should be underlain by at least 6 inches of Class 2 aggregate base compacted to at least 95 percent of the maximum dry density (relative compaction) in accordance with ASTM D1557[1]. Prior to placement of the aggregate base, the exposed native subgrade should be prepared per Section 6.12.2.

Membrane Slab Foundation

The proposed circumferential footing along the perimeter of the proposed water storage tank should be designed using allowable bearing pressures of 3,200 psf for dead plus sustained live loading. Given this bearing pressure, total settlement of the perimeter footing should be on the order of ½ inch or less. The allowable bearing pressure may be increased by one-third when considering short-term loading due to wind or seismic forces. Total settlement near the center of the membrane slab should be on the order of 1 to 1¼ inch. According to ACI 372R-21, the differential settlement between the tank perimeter and center should be well within tolerable limits.

A k-value or coefficients of subgrade reaction (assuming a square plate measuring 1 foot by 1 foot) of 220 pounds per cubic inch (pci), a Young's modulus (E_s) of 350 kips per square foot (ksf), and a Poisson's ratio (μ_s) of 0.3 may be used for design based on the unsaturated subgrade soil conditions encountered at the site.

Based on the assumption that the proposed tank will be backfilled with non-plastic silt and/or sand (Section 6.12.5), a downward drag coefficient of 0.40 between the tank wall and the backfill may be used to determine short-term loading effects on the circumferential footing from the backfill.

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[1] *This test procedure should be used wherever relative compaction, maximum dry density, or optimum moisture content is referenced within this report.*

The membrane slab foundations should be underlain by at least 6 inches of Class 2 aggregate base compacted to at least 95 percent relative compaction. Prior to placement of the aggregate base, the exposed native subgrade should be prepared per Section 6.12.2. The aggregate base should be underlain by a PVC liner recommended and installed per the tank manufacturer.

Ring-Wall Foundation

The proposed ring-wall foundation should have a minimum width of 18 inches and be embedded at least 24 inches below the lowest final adjacent subgrade. Footings so established may be designed using a net allowable bearing pressure of 2,500 psf for dead plus sustained live loading. A one-third increase in allowable bearing pressure may be applied when considering short-term loading due to wind or seismic forces.

We estimate that total settlement near the center of tank prior to filling will be less than ½ inch. Once filled, we estimate the center of the tank could settle 1 to 1½ inches. To reduce long-term differential movement and stresses in the tank bottom plates, consideration should be given to grading the tank pad fill in a conical shape with the central portion raised about 2 to 3 inches, then gently sloping to the outside edges of the fill. If the tank bottom plate and the shell will be structurally tied together, structural design should equalize loading on the ring-wall and tank in order to reduce stress and differential movement.

The interior tank pad fill should consist of at least 12 inches of Class 2 aggregate base compacted to at least 95 percent relative compaction. Prior to placement of the fill, the exposed native subgrade should be prepared per Section 6.12.2.

General

The structural engineer should evaluate footing configurations and reinforcement requirements to account for loading, shrinkage, and temperature stresses. The ring-wall foundation design should take into account hoop tension caused by the lateral earth pressure inside the perimeter foundation due to product surcharge and tank dead load.

Prior to placing steel or concrete, foundation excavations should be cleaned of all debris, loose or soft soil, and water. If shrinkage cracks appear in the foundation excavations, the excavations should be thoroughly moistened to close all cracks prior to placement of concrete. All foundation excavations should be observed by the project Geotechnical Engineer or a designated representative just prior to placing steel or concrete to confirm that the recommendations contained herein are implemented during construction.

The proposed tanks should be initially loaded in 1/3 increments, allowing for the initial settlement to occur between the incremental loads. Accordingly, a monitoring program should be established to evaluate total and differential settlement during the initial loading and for six months thereafter. The monitoring program should include at least 6 survey points for the proposed water storage tank and 4 survey points for the proposed backwash recycle tank established along the perimeter of the tanks. The Geotechnical Engineer should evaluate the results after each survey reading.

If pipes or other conduits entering or leaving the tank are sensitive to the anticipated differential movement, flexible connections should be used until the tank has been filled and settlement is complete. Thereafter, rigid connections may be installed.

Leaking pipelines under or near the proposed tanks and leaking tank joints or seams could potentially trigger some isolated heave or settlement as the moisture content of the native soil increases. Periodic inspections for leaks should be performed during the life of the tanks and connecting pipelines. If leaks are found, the tanks should be taken out of service and repaired. If the proposed project requires a higher performance standard than currently assumed, the tank manufacturers should be notified so that additional leak control measures can be implemented in the tank and pipe design.

6.3 Equipment Pads

We anticipate the proposed booster station and horizontal filter equipment will be supported on 5 to 15 foot wide concrete equipment pads. Structural loading (dead-plus-live) is anticipated to be relatively light, 600 psf or less. Given these details, total settlement should be on the order of ½ inches or less and the maximum differential settlement, assuming the structural slab will be designed using the conventional rigid method, should be on the order of about ½ inch or less. The net allowable bearing pressure may be increased by one-third when considering short-term loading due to wind or seismic forces.

The concrete equipment pads should be at least 6 inches thick and underlain by at least 12 inches of Class 2 aggregate base compacted to at least 95 percent relative compaction. Prior to placement of the aggregate base, the exposed native subgrade should be prepared per Section 6.12.2. As an alternative, the Class 2 aggregate base could be reduced to a minimum of 4 inches and the subgrade soils could be improved/stabilized by mixing the upper 12 inches of native clay with high calcium quick lime (lime treatment). Specific recommendations and criteria for lime treatment are presented in Section 6.12.3. A brief discussion regarding the cost/benefit of lime treatment is presented in Section 6.4.

6.4 Treatment and Electrical Buildings

The proposed treatment and electrical buildings are anticipated to be small single-story, masonry structures with conventional spread foundations and concrete floor slabs. The following presents recommendations for foundations and floor slabs.

Shallow Spread Foundations

The proposed structures may be supported on reinforced concrete spread footings founded on undisturbed native soil, structural fill, or a combination of both. A net allowable bearing pressure of 2,000 psf for dead plus sustained live loading may be used to size column and continuous footings supported by these materials. A one-third increase in the allowable bearing pressure may be applied when considering short-term loading due to wind or seismic forces.

Even though computed footing dimensions may be less, continuous bearing wall and column footings should have minimum widths of 12 and 24 inches, respectively, to facilitate hand cleaning of the footing excavations. Due to the expansive soil considerations discussed in Section 6.1, all interior and exterior footings should be embedded at least 18 and 24 inches, respectively, below the lowest final adjacent subgrade[2]. At this depth, foundations should be supported below the critical zone of seasonal moisture fluctuations where soil shrink-swell cycles are most severe. In addition, perimeter continuous foundations around the proposed buildings would serve as a horizontal moisture break, reducing the potential for seasonal or man-made wetting and drying below the structures. Accordingly, continuous foundations should extend the entire perimeter of the buildings, including door openings.

Total settlement of an individual foundation will vary depending on the plan dimensions of the foundation and the actual load supported. Based on the assumed foundation dimensions and loads, we estimate maximum total and differential foundation settlements should be on the order of 1/2 inch or less.

Concrete Floor Slabs

As previously noted, the near-surface clay can exhibit significant expansion or swelling with seasonal and man-made increases in moisture content. Given the anticipated project details, two soil improvement alternatives (non-expansive fill and lime treatment) appear reasonable from constructability and cost standpoints to reduce potential post-construction heave to within generally accepted or tolerable levels. Both approaches have been successfully used in the project area and are common. The recommendations herein are contingent upon the assumption that the quality control,

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[2] *Within this report, subgrade refers to the top surface of undisturbed native soil, native soil compacted during site preparation, lime treated soil or structural fill.*

surface drainage and landscaping criteria discussed herein will be implemented during and following construction.

This first option consists of placing at least 18 inches of non-expansive fill directly below the proposed structures by removing and replacing the native clay, raising the building pad above existing site grade, or a combination of both. The zone of non-expansive soil should extend laterally at least 3 feet outside the perimeter of the structures. Specific fill and compaction requirements are presented in Sections 6.12.5 and 6.12.6, respectively.

Prior to placement of the non-expansive fill, the exposed clay subgrade soil should be uniformly moisture conditioned and compacted per Section 6.12.2 unless otherwise approved by the Geotechnical Engineer. The moisture content of the clay should be maintained until placement of the non-expansive fill.

The second option (lime treatment) would be to improve/stabilize the subgrade conditions by mixing the upper 16 inches of native clay in the proposed structure areas with high calcium quick lime. The zone of lime-treated soil should extend laterally at least 3 feet outside the perimeter of the proposed structures. Following lime treatment, the mixed soil should be compacted as structural fill. Specific recommendations and criteria for lime treatment are presented in Section 6.12.3.

The following summarizes the various advantages and disadvantages for each option from a geotechnical standpoint:

Option	Advantages	Disadvantages
Non-Expansive Fill	Tends to provide some resistance to up-lift forces by increasing the dead-load imposed on the clay	Typically highest cost option
	Lowest risk option since the near-surface clay most susceptible to expansion is removed and replaced	
	Should the native clays experience some isolated swelling, concrete slabs tend to exhibit a more uniform heave pattern.	
Lime Treatment	Typically more cost effective	Represents a higher risk option if quality control is not adequate during construction
	Lime acts as a cementing agent, increasing the strength and decreasing the flexibility of the soil. Slabs supporting equipment, traffic or concentrated loads exhibit less deflection and tend to perform better overall	Lime increases the pH of the soil and does not promote plant growth.
	During or following rainfall, lime treated soil tends to remain reasonably stable, thus providing a firm, accessible working platform for construction.	Underground utilities should be installed prior to lime treatment; otherwise, the utility trenches need to be backfilled with CLSM.

General

The Structural Engineer should evaluate footing configurations and reinforcement requirements to account for loading, shrinkage, and temperature stresses. As a minimum, continuous footings for the buildings should be reinforced with at least four No. 4 reinforcement bars, two top and two bottom, to provide structural continuity and permit spanning of local subgrade irregularities. The project Structural Engineer should also provide the final design slab thickness, reinforcement and concrete strength requirements. Care should be taken to place, consolidate, and cure concrete in accordance with American Concrete Institute (ACI) standards and criteria.

Prior to placing steel or concrete, foundation excavations should be cleaned of all debris, loose or soft soil, and water. If shrinkage cracks appear in the footing excavations, the excavations should be thoroughly moistened to close all cracks prior to placement of concrete. All footing excavations should be observed by the project Geotechnical Engineer or a designated representative just prior to placing steel or concrete to confirm that the recommendations contained herein are implemented during construction.

Groundwater should not rise near surface and adversely impact the structural performance of the concrete floor slabs. If concrete floor slabs will be covered with moisture-sensitive flooring or support moisture sensitive equipment, a capillary break should be placed between the finished subgrade soil and the concrete slabs. The capillary break should consisting of at least 4 inches of free draining crushed gravel that, in turn, is overlain by a flexible sheet membrane, such as Stego Wrap™, Moistop Plus™, or an equivalent meeting the requirements of ASTM D1745-96. The crushed gravel should meet the requirements of Section 10-14 of the City's current Standard Specifications. Care should be taken to properly place, lap and seal the membrane in accordance with manufacturer's recommendations to provide a vapor tight barrier. Tears and punctures in the membrane should be completely repaired prior to placement of concrete. The capillary break should not replace in whole or in part the *Non-Expansive or Lime Treated* soil layer discussed above unless approved by the Geotechnical Engineer.

A 1- to 2-inch thick layer of relatively dry sand meeting the requirement of Section 10-13 of the City's current Standard Specifications should be placed over the membrane to promote uniform curing of concrete and to protect the membrane. The moisture content of the sand should not exceed 4 percent by dry weight. If the sand becomes overly wet, it should be removed and replaced with suitable sand.

6.5 Lateral Resistance

Resistance to lateral loads (including those due to wind or seismic forces) may be determined using an at-rest coefficient of friction of 0.50 between the bottom of cast-in-place concrete foundations or slabs and the underlying soils. Lateral resistance for foundations can alternatively be provided by the passive soil pressure acting against the vertical face of the footings. The passive pressures available in undisturbed native soils and structural fill or lime treated soil may be taken as equivalent to pressures exerted by fluids weighing 350 and 450 pounds per cubic foot (pcf), respectively. These two modes of resistance can be combined. However, since horizontal movement is required to mobilize passive resistance, the allowable at-rest frictional resistance should be reduced by 50 percent.

Lateral resistance parameters provided above are ultimate values. Therefore, a suitable factor of safety should be applied for design purposes. The appropriate factor of safety will depend on the design condition and should be determined by the project Structural Engineer. If a capillary break, similar to the system discussed in Section 6.4, is placed below concrete floor slabs, the slab design should assume that no lateral resistance is provided by the slab.

6.6 Lateral Earth Pressures

We understand that the proposed water storage tank will be partially buried. In this case, the tank walls should be designed to resist the earth pressure exerted by the retained, compacted backfill plus any additional lateral force due to surcharge loading, i.e., heavy construction equipment, foundations, etc., at or near the tank wall. The following equivalent fluid earth pressures are recommended assuming a buried tank wall height of 10 feet and a moist unit weight of 125 pounds per cubic foot (pcf) for the compacted backfill soil. The following equivalent fluid earth pressures also assume that the water tank manufacturer will design and install an appropriate subsurface drain system along the perimeter of the partially buried tank in order to provide a drained backfill condition:

Earth Pressure Condition	Backfill Slope	Lateral Earth Pressure (pcf)
Active	Level	35
At-Rest	Level	55

Tank walls capable of deflecting a minimum of 0.1 percent of their height at the top may be designed using the active earth pressure. Tank walls incapable of this deflection or that are fully restrained against deflection should be designed for the at-rest earth pressure. Where uniform surcharge loads are located within a lateral distance from constrained and unconstrained walls equal to the buried height of the

tank wall, 45 and 30 percent of the surcharge load, respectively, should be applied uniformly over the entire buried height of the tank wall. A uniform surcharge load equivalent to two feet of compacted soil (250 psf) should be applied to the entire buried height of the tank wall for design to account for light vehicles and moderately heavy service truck loads that may encroach near the tank.

Buried walls will be subject to increased lateral earth pressures during seismic shaking. Using the Mononobe-Okabe theory as described by Seed and Whitman (1970), a dynamic fluid earth pressure of 20 pcf should be added to the static active earth pressure for unrestrained walls and subtracted from the passive equivalent fluid earth pressure. The dynamic pressure component is distributed on the wall as an inverted triangle in shape with the maximum value at the top of the wall. The resultant of the earthquake-induced earth pressure may be assumed to act on the wall at a point (0.6 x wall height) above the base of the wall.

For rigid or restrained walls, the applicability of the Mononobe-Okabe theory is not direct, but there is a supporting reference (Nadim and Whitman, 1992) that suggests the theory can be used to rigid walls. Because it is assumed that during seismic shaking there is sufficient movement to allow for the development of active earth pressures, the total dynamic lateral pressure can be estimated by adding the dynamic pressure increment (as indicated above) to the static earth pressure force computed using the active (rather than the at-rest) equivalent fluid pressure.

6.7 Surface Drainage and Landscaping

Foundation and slab performance depends greatly on how well surface runoff water drains from the site. Accordingly, positive drainage should be provided away from the proposed structures toward appropriate drop inlets or other surface drainage devices without ponding. The drainage should be maintained both during construction and over the life span of the facility. Landscaping after construction should not promote ponding of water adjacent to the proposed structures. Roof draining should be installed with appropriate downspout extensions outfalling on splash blocks so that water is directed a minimum of 5 feet horizontally away from the structures or be connected to the storm drain system for the facility. Care should be taken to not over irrigate landscape areas and to maintain a leak free sprinkler piping system.

Potential man-made water sources such as buried pipelines, drains, and the like should be periodically tested and/or examined for signs of leakage or damage. Any such leakage or damage should be promptly repaired.

6.8 Pavement

Subgrade Preparation

Per our discussion in Section 6.1, the near-surface soil at the project site consists of potentially expansive clay that poses a potential risk for post-construction heave and cracking of pavements. In order to reduce this risk and improve the pavements service life or life cycle, the subgrade soils in pavement areas should be prepared as recommended in Section 6.12.2.

In lieu of supporting pavement directly on expansive clay, the subgrade soil can be stabilized by mixing the clay with lime (lime treatment). Pavements underlain by lime treated soils tend to require lower maintenance and, thus, have a longer life cycle. Furthermore, the aggregate base sections for pavements supported on lime treated soil are thinner than for pavements supported on native soil, thus reducing the relative cost of the lime treatment. Specific recommendations and criteria for lime treatment are presented in Section 6.12.3. During construction, the zone of lime-treated soil should extend laterally at least 2 feet beyond the perimeter of the pavements. If the lime-treated soil extends into planter areas, the treated soil should be completely removed within the planter area and replaced prior to planting.

Pavement Sections

The results of our laboratory tests indicate that the native subgrade soil will exhibit poor support characteristics for pavements as represented by an R-value of less than 5.

Pavement sections (determined in units of inches rounded up to the nearest ½ inch) are presented below based on the following criteria:

- A minimum R-value of 5 for the native subgrade soil and a minimum R-value of 50 for lime treated soil
- A minimum lime-treated soil compressive strength of 200 psi.
- Gravel equivalency factor for the lime-treated soil of 1.1.
- Minimum and maximum depths of lime-treated soil of 12 and 18 inches, respectively.
- Three inches of lime-treated soil has been added to the calculated pavement sections. Based on our experience, it is difficult for the contractor to consistently achieve the required compaction near the bottom of thick, lime-treated sections. Also, the underlying native (untreated) soils are not compacted as they would be for conventional pavements. The additional lime treated soil compensates for these two factors.

- Because pavement at the facility will not support high speed impact loads, such as on a freeway or major arterial, the pavement sections do not include a Gravel Equivalent Safety Factor (per County Engineers Association and the League of California Cities criteria).

Traffic Index	Typical Pavement Area	Asphalt-Concrete (inches)	Class 2 Aggregate Base (inches)	Lime-Treated Soil (inch)
5	Parking and drive areas supporting light cars and trucks and occasional delivery trucks	2	12	--
			4	12
5½	Fire truck access lanes or other pavement areas supporting no greater than one 3 to 5 axle truck per day	2½	13	--
			4	13
6	Pavement areas supporting no greater than four 3 to 5 axle trucks per day	2½	15	--
			4	14
6½	Pavement areas supporting light to moderately heavy cranes or no greater than seven 3 to 5 axle trucks per day	3	16	--
			4	16
7	Pavement areas supporting heavy cranes or no greater than thirteen 3 to 5 axle trucks per day	3	17½	--
			5½	17

The City and/or project designer should review the pavement sections and evaluate the suitable T.I.'s for this project.

General

The pavement sections provided above are contingent on the following recommendations being implemented during construction.

- Aggregate base and asphalt concrete materials and placement methods should conform to the current Caltrans Standard Specifications.
- Class 2 aggregate should be compacted as engineered fill to at least 95 percent relative compaction.
- Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base are not allowed to become wet. To improve the long-term performance of the pavement, consideration should be given to placing edge drains or barriers between the pavement

and irrigated landscaping or areas that may pond water. The edge drains or barriers should extend a minimum of 4-inches below the aggregate base and into the subgrade soil. Additional details regarding these systems can be provided upon request.

- Periodic maintenance should be performed to repair degraded areas and seal cracks with appropriate filler.

6.9 Water Transmission Main

The subsurface soils encountered adjacent to the proposed water main alignment consisted of very stiff to hard, low to high plastic clay and silt with an Interbedded strata of medium dense silty sand. Given these conditions, the City's Standard Plans and Specifications should be suitable for construction of the proposed main.

6.10 Geologic Hazards

Ground Motion

The project area is characterized by recurring seismic activity. During the design life of the proposed storage reservoir it is probably that at least one moderate to severe earthquake will cause strong ground shaking in the vicinity of the project.

A ground motion study for this project was completed by the RMA Group using design criteria specified in the American Water Works Association (AWWA) Standard D110-04 and the 2009 International Building Code (IBC-09) for the following earthquake probability scenarios:

- 2% probability of exceedance in 50 years
- 10% probability of exceedance in 50 years
- 10% probability of exceedance in 100 years

A copy of the ground motion study is presented in Appendix C.

Ground Rupture

Earthquakes are caused by the sudden displacement of earth along faults with a consequent release of stored strain energy. The fault slippage can often extend to the ground surface where it is manifested by sudden and abrupt relative ground displacement. Damage resulting from fault rupture occurs only where structures are located astride the fault traces that move. No active faults have been mapped or known to cross the site, nor does it lie within a Fault-Rupture Hazard Zone (formerly

Alquist-Priolo Special Studies Zone, Hart, 1990). Due to the non-existence of active faults on or near the site, the likelihood of surface rupture is considered low.

Liquefaction

A common secondary hazard as a result of strong ground shaking is the potential for soil liquefaction and subsidence. Liquefaction describes a phenomenon in which saturated soil loses shear strength and deforms as a result of increased pore water pressure induced by strong ground shaking during an earthquake. Dissipation of the excess pore pressures will produce volume changes within the liquefied soil layer, which can manifest at the ground surface as settlement of structures, floating of buried structures, and failure of retaining walls. Factors known to influence liquefaction include soil type, grain size, relative density, confining pressure, depth to groundwater, and the intensity and duration of ground shaking. Soils most susceptible to liquefaction are saturated, loose sandy soils.

The potential for an earthquake with the intensity and duration characteristics capable of promoting liquefaction is a possibility during the design life of the project. However, given the subgrade soils encountered are generally high in clay content and/or relatively stiff/dense and groundwater was encountered at a depth of about 48 feet, the potential for liquefaction is considered remote.

Dynamic Settlement

Dry, loose sands and non-plastic silts may experience some settlement or subsidence when subjected to cyclic application of loads such as ground shaking from near-by seismic events. Since the near-surface soils consist predominately of plastic clays and silts, the potential for settlement as a result of ground shaking is considered low.

Landsliding

Since the project site is essentially level, there are no significant slopes near the site boundary, and the subgrade soils are considered non-liquefiable, the potential for seismically induced slope instability is considered remote.

6.11 Soil Corrosion

Chemical tests performed on five selected subgrade soil samples indicated pH's ranging from 6.2 to 8.5, water soluble sulfate contents ranging from 2.99 to 65.8 parts per million (milligrams per kilogram), and chloride concentrations ranging from 3.87 to 183 ppm. The ACI Manual of Concrete Practice, Section 201.2R-92, recommends using Type II cement for foundations placed in these soils. In accordance with California Test 532, "if the chloride concentration is determined to be less than 500 ppm," "the influence of the chloride-ion at this level is considered to be non-corrosive."

Minimum resistivity tests performed on the same soil samples indicated that the soil is moderately corrosive to corrosive to buried metal objects as indicated by results ranging from 1,400 to 7,800 ohm-centimeters. A commonly accepted correlation between soil resistivity and corrosivity towards ferrous metals is provided below:

Soil Resistivity	Corrosivity
0 to 1,000 ohm-cm	Severely corrosive
1,000 to 2,000 ohm-cm	Corrosive
2,000 to 10,000 ohm-cm	Moderately corrosive
Over 10,000 ohm-cm	Mildly corrosive

A more detailed summary of the soil corrosivity tests performed by SunStar Laboratories, Inc. is presented in Appendix B. These tests are only an indicator of soil corrosivity. A competent corrosion engineer should be retained to design corrosion protection systems appropriate for the project.

6.12 General Earthwork

The following presents recommendations for general earthwork criteria. Previous sections should be reviewed for specific or supplemental earthwork recommendations.

6.12.1 Site Stripping

Prior to general site grading, surface vegetation, organic topsoil, and any debris should be removed and disposed of outside the construction limits. Depending on the concentration of vegetation, it may be possible to mow and rake off the surface vegetation and disc the remaining roots into the surface during subgrade preparation. The organic content of the disced soil (as determined by loss-on-ignition tests) should not exceed 5 percent by weight. Deep stripping will be required where concentrations of organic soils or tree roots are encountered during site grading. The depth of stripping and/or discing should be determined in the field by a City representative prior to earthwork. Upon approval of the City and/or landscape architect, stripped topsoil (less any debris) may be stockpiled and placed in landscape areas. This material, however, should not be incorporated into any structural fill.

6.12.2 Subgrade Preparation

All native subgrade soils that will receive structural fill, non-expansive fill or aggregate base or otherwise support structures and pavement should be scarified or ripped to a minimum depth of 12 inches below the finished subgrade elevation and uniformly moisture conditioned to a moisture content ranging from 2 to 5 percentage points

above the optimum moisture content. In the proposed backwash recycle tank, equipment pad and building areas, the subgrade soils should be compacted to at least 88 percent relative compaction and not greater than 95 percent of the maximum dry density (relative compaction) as determined by ASTM Test Method D 1557[3]. In the proposed pavement and water storage tank areas, the upper 6 inches of subgrade soil should be compacted as engineered fill to at least 95 percent relative compaction. The underlying 6 inches of moisture conditioned subgrade soil should be compacted to at least 90 percent relative compaction. Specific recommendations and criteria for lime treatment are presented in Section 6.12.3.

The subgrade soil should be in a stable, non-pumping condition at the time fill or aggregate base materials are placed and compacted. The moisture content of the soils should be maintained until placement of the fill or aggregate base by liberal sprinkling with water or other suitable method. A representative from the City should perform a field check of the soil moisture content and relative compaction prior to placement of structural fill, non-expansive fill, and aggregate base.

In-place scarification and compaction may not be adequate to densify all disturbed soil within areas grubbed or otherwise disturbed below a depth of about 12 inches. Therefore, overexcavation of disturbed soil, scarification and compaction of the exposed subgrade, and replacement with structural fill may be required to sufficiently densify all disturbed soil.

6.12.3 Lime Treatment

Lime treatment, including the subgrade preparation, spreading, mixing, compaction and lime quality, should meet the requirements outlined in Section 24 of the Caltrans Standard Specifications. Based on our previous experience, 4½ percent high calcium quick lime by dry weight of the soil may be assumed for estimating purposes based on a dry soil unit weight of 110 pcf.

The upper 12-inches of lime treated subgrade soil should be compacted to at least 95 percent relative compaction. Lime treated subgrade soil below the upper 12-inches should be compacted to at least 90 percent relative compaction.

Although lime treatment has performed well for many developments in the general project area, isolated problems have occurred due to a lack of quality control during construction. The problems involved post-construction swelling of the subgrade soils caused by improper moisture conditioning of the native clay prior to lime treatment and/or inadequate curing of the compacted lime treated soils. Accordingly, these factors are considered critical to the long term performance of the proposed structures. At least 2 to 3 days prior to spreading or mixing the lime, the moisture content of the

[3] *This test procedure should be used wherever relative compaction, maximum dry density, or optimum moisture content is referenced within this report.*

underlying, untreated soil should be checked. If the soil moisture content is found to be dry of optimum, the soil moisture content should be raised using liberal sprinkling, flooding or another suitable method.

Curing is typically performed by continually sprinkling the surface of the lime treated soil with water to keep it damp, combined with light rolling to keep the surface knitted together. We suggest that pavement or slab areas be covered with aggregate base or crushed rock within 2 to 3 days of the lime treatment in an effort to protect the pad and reduce drying. Periodic sprinkling should still be performed to keep the lime treated surface damp. As an alternative, a curing seal could be applied to the lime-treated soil within one day after final compaction. A criterion for type and placement of the curing seal is presented in Section 24 of the Caltrans Standard Specifications. The curing seal may need to be reapplied several times during the curing period

At least two weeks prior to earthwork operations, a representative of the City should review the lime treatment contractor's proposed procedures. Laboratory tests may be needed in order to assess or revise the required lime application rate. During earthwork operations, the City representative should be on-site to document spreading, mixing and compaction operations and to provide supplemental/revised recommendations, if warranted, based on the soil conditions observed.

Lime treatment increases the pH of the soil and does not promote plant growth. Accordingly, treatment should not be performed in landscape areas or the lime-treated soils should be completely removed and replaced prior to planting.

Where possible; underground utilities should be installed prior to lime treatment. If utilities are installed after lime treatment, the utility trenches should be backfilled using controlled low strength material (CLSM) that meets the requirements of the City's Standard Specifications.

6.12.4 Temporary Excavations

Construction site safety generally is the sole responsibility of the Contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations. The Contractor should be aware that slope height, slope inclination, or excavation depths (including utility trench excavations) should in no case exceed those specified in local, state, and/or federal safety regulations (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations). Flatter slopes and/or trench shields may be required if loose, cohesionless soils and/or water are encountered along the slope face. Heavy construction equipment, building materials, excavated soil, and vehicular traffic should not be allowed within a lateral distance equal to one-third the slope height from the top of any excavation. During wet weather, earthen berms or other methods should be used to prevent runoff water

from entering all excavations. All runoff water or seepage encountered within excavations should be collected and disposed of outside the construction limits.

6.12.5 Fill Materials

The native soils encountered in our borings, minus organics, debris and/or other deleterious materials, should be suitable for use as general fill in proposed pavement and building areas. The native clay, however, is moderate to highly plastic and potentially expansive and should not be used for backfill directly against the proposed water tank wall or other retaining structure unless approved by a City representative. A wedge of non-expansive fill material should extend from the bottom of the tank wall or other retaining structure outward and upward at a slope of at least 1(h):1(v) or flatter.

All import fill or soils used for non-expansive fill should be nearly free of organic or other deleterious debris, essentially non-plastic, and less than 3 inches in maximum dimension. In general, well-graded mixtures of gravel, sand, non-plastic silt, and small quantities of cobbles, rock fragments, and/or clay are acceptable for use as import and non-expansive fill. All fill materials to be used for structural fill should be sampled and tested by a City representative prior to being transported to the site. Specific requirements for import and non-expansive fill are provided below.

Gradation (ASTM C136)	
Sieve Size	Percent Passing
3-inch	100
No. 4	50 – 100
No. 200	15 – 70
Plasticity (ASTM D4318)	
Liquid Limit	Plasticity Index
Less than 30	Less than 12
Organic Content (ASTM D2974)	
Less than 3 percent	

Utility trenches backfilled with sand or other permeable material can act as a conduit for exterior surface water to enter below structures. Accordingly, all pipeline excavations that extend below the proposed tanks, equipment pads, and buildings should be backfilled with CLSM or slurry cement backfill that meets the City's Standard Specifications. CLSM or slurry cement backfill should extend a minimum lateral distance of 2 feet outside the proposed structure where possible.

6.12.6 Structural Fill

All fill soils, either native or imported, required to bring the site to final grade should be compacted as structural fill. Fill composed of potentially expansive clay should be uniformly moisture conditioned to a moisture content ranging from 2 to 5 percentage points above the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent relative compaction and not greater than 95 percent relative compaction, unless approved by a designated City representative.

Structural fill composed of native or imported, low plastic sand and silt should be uniformly moisture conditioned to a moisture content ranging from 1 to 4 percentage points above the optimum moisture content, placed in horizontal lifts less than 8 inches in loose thickness, and compacted to at least 90 percent relative compaction.

Additional fill lifts should not be placed if the previous lift did not meet the required dry density or if soil conditions are not stable. Discing and/or blending may be required to uniformly moisture condition soils used for structural fill. All trench backfill in building or other structural areas should be placed and compacted in accordance with the recommendations provided above for structural fill. During backfill, only mechanical compaction of structural fill is recommended.

If heavy equipment will be used for compaction of structural fill, the Structural Engineer and/or tank manufacture should be consulted to provide setback criteria to avoid overstressing of the tank wall based on the type and weight of the compaction equipment. Within the setback zone, only hand operated equipment ("whackers," vibratory plates, or pneumatic compactors) should be used to compact the backfill soils.

6.12.7 Wet/Unstable Subgrade Mitigation

Based on our findings, groundwater levels are not anticipated to rise near surface or impede grading operations at the site. However, if site grading is performed during or following extended periods of rainfall, the moisture content of the near-surface soils may be significantly above optimum. In addition, near-surface "perched" groundwater may be encountered above the hard silts and clays. These conditions, if encountered, could seriously delay grading by causing an unstable subgrade condition. Typical remedial measures include discing and aerating the soils during dry weather, mixing the soils with dryer materials, removing and replacing the soils with an approved fill material, or stabilization with a geotextile fabric or grid. A City representative should be consulted prior to implementing any remedial measure to observe the unstable subgrade condition and provide site-specific recommendations.

7.0 ADDITIONAL SERVICES

The review of plans and specifications, field observations, and testing is integral to document that the intent of our recommendations have been implemented in the project design and construction. A City representative should observe and document the earthwork operations, including any lime treatment, and test the subgrade and fill to verify compliance with our recommendations and the project specifications.

8.0 LIMITATIONS

1. The conclusions and recommendations of this report are for design purposes as described in the text of this report. The conclusions and recommendations in this report are invalid if:

   - The assumed structural or grading details change
   - The report is used for adjacent or other property
   - Changes of grades and/or groundwater occur between the issuance of this report and construction
   - Any other change is implemented which materially alters the project from that proposed at the time this report was prepared

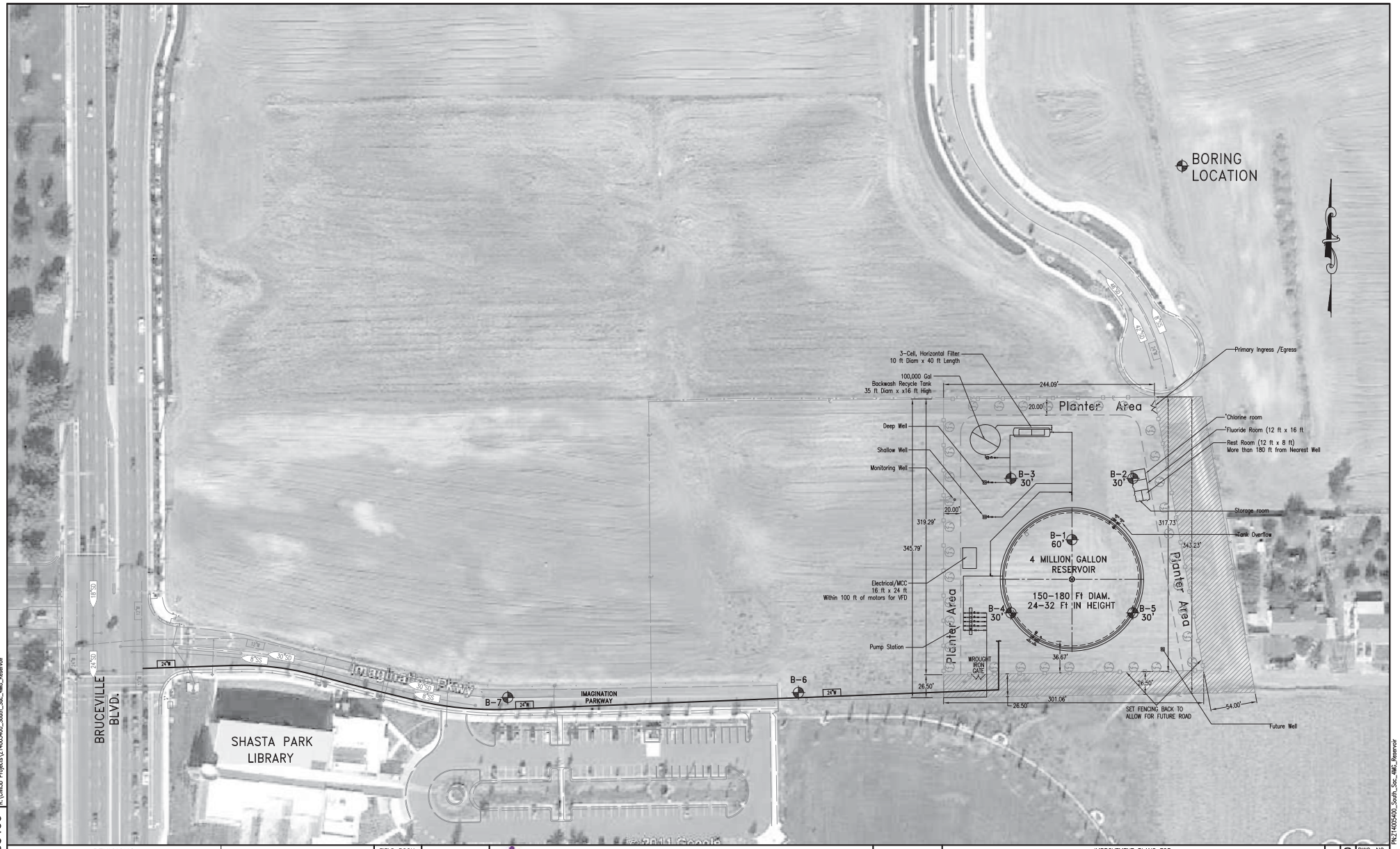
2. The conclusions and recommendations in this report are based on the borings drilled for this investigation. It is possible that variations in the soil conditions exist between or beyond the points of exploration, or the groundwater elevation may change, both of which may require additional investigations, consultation, and possible design revisions.

3. We are not corrosion engineers. A competent corrosion engineer should be retained to design corrosion protection systems appropriate for the project.

4. This report was prepared in accordance with the generally accepted standard of practice that existed in Sacramento County at the time the report was written. No warranty, expressed or implied, is made.

5. It is the project manager's responsibility to see that all parties to the project, including the designer, contractor, subcontractor, etc., are made aware of this report in its entirety.

6. This report should be used only for the purposes stated within a reasonable time from its issuance. Land use, site conditions (both on- and off-site), or other factors may change over time, and additional work may be required. Based on the intended use of the report, additional work may need to be performed and an updated report issued.



REVISIONS			
NO.	DESCRIPTION	DATE	BY

BENCH MARK
DESCRIPTION: 338-B7B
ELEV. 27.272'
HILTI NAIL IN TRANSMISSION TOWER BASE
WEST SIDE OF BRUCEVILLE ROAD, NORTH OF
THE COLLEGE ENTRANCE

FIELD BOOK 1462
SCALE:
H: 1"=50'
V:

1"
ON ORIGINAL SCALE DRAWING ADJUST SCALED DIMENSIONS IF THIS DOES NOT SCALE AT 1"

CITY OF SACRAMENTO
DEPARTMENT OF UTILITIES

DRAWN BY: A. VELAZQUEZ
DATE: OCTOBER 2011
DESIGNED BY: BRETT E.
R.C.E. NO. CXXXXX DATE: OCT 2011
CHECKED BY: DAN S.
R.C.E. NO. CXXXXX DATE: 2011

IMPROVEMENT PLANS FOR:

WATER DISTRIBUTION IMPROVEMENTS
4 MG RESERVOIR – SOUTH SACRAMENTO
OVERALL SITE PLAN

GIS GRID NO.
CGT GS?
PN: X14005400

DWG. NO. C-2
SHEET 4 OF 22

PN:X14005400_South_Sac_4MG_Reservoir

R:\Civil3D Projects\X14005400_South_Sac_4MG_Reservoir
4 MG RESERVOIR - SOUTH SACRAMENTO

APPENDIX A
LOGS OF BORINGS

EXPLORATORY BORING LOG

Project:	Shasta Park Geotechnical Investigation	Drilling Equipment:	CME 75 – Hollow Stem Auger
Date Drilled:	1-26-2012 to 1-27-2012	Borehole Diameter:	8"
Logged By:	J. Summers	Drive Weight:	140 lbs.
Location:	See Site Map	Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows* (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description	Penetrometer Reading (TSF)
						CH		Dark Greyish Brown Fat CLAY w/ Sand - moist	
	T	6-14-29 (43)	▨	11.4	113.9	CL		Light Brown and Light Reddish Brown Lean CLAY w/ Sand – moist, hard	> 4.5
5	T	13-31-34 (65)	▨	14.9	104.5	SM		Light Reddish Brown Silty SAND – slightly moist, medium dense	
						CL		Light Greyish Brown Lean CLAY w/ Sand – slightly moist, hard, charcoal specks, white streaks	> 4.5
10	T	5-12-17 (29)		19.6	95.8	ML		Light Brownish Grey Sandy SILT– moist, hard, white streaks	4.25
15	T	6-18-27 (45)		20.0	92.3	ML		Greyish Brown Lean SILT w/ Sand – moist, hard, red mottling, charcoal specks, white streaks	> 4.5
20	T	6-18-27 (45)				CL		Light Greyish Brown Lean CLAY w/ SAND – moist, hard, red mottling, charcoal specks	> 4.5
25	T	3-8-13 (21)		30.5	81.4	ML		Dark Brownish Red Lean SILT w/ Sand – moist, hard, some fine tubular voids.	> 4.5
30	T	4-11-14 (25)		30.5	81.4			Becoming more red and more sandy with depth, stiff to very stiff	2.0
35	T	7-8-12 (20)						Becoming less sandy, charcoal specks, hard	> 4.5
				14.1	91.9				

Material Description: This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log shows subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

*Note: All blow counts associated with a tube sampler are uncorrected. The sampler dimensions are as follows:
O.D. = 2.5" I.D. = 2.0"

Sample Types
R - Ring Sample
- Bulk Sample
- Groundwater
T - Tube Sample
S - SPT Sample
- End of Boring

EXPLORATORY BORING LOG

Project:	Shasta Park Geotechnical Investigation	Drilling Equipment:	CME 75 – Hollow Stem Auger
Date Drilled:	1-26-2012 to 1-27-2012	Borehole Diameter:	8"
Logged By:	J. Summers	Drive Weight:	140 lbs.
Location:	See Site Map	Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows* (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description	Penetrometer Reading (TSF)
	T	6-7-12 (19)		17.1	87.4	ML		Dark Reddish Brown Fine Sandy SILT – moist, very stiff to hard, some light brown mottling	4.0
45	T	6-6-9 (15)		27.9	88.8	SM		Dark Reddish Brown Silty SAND – very moist, medium dense	
50	T	3-4-6 (10)							
						SP		Dark Brown and Grey Poorly Graded SAND – wet, loose	
55	T	1-1-19 (20)						Dark Grey Gravelly Poorly Graded SAND – wet, medium dense, contains rounded, sub-rounded, angular and sub-angular gravel up to 1.5", evidence of fractured rock	
60									
65									
70								Boring terminated at 70 feet due to drilling refusal Groundwater encountered at 48 feet	
75									

Material Description

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EXPLORATORY BORING LOG

Project:	Shasta Park Geotechnical Investigation	Drilling Equipment:	CME 75 – Hollow Stem Auger
Date Drilled:	1-26-2012 to 1-27-2012	Borehole Diameter:	8"
Logged By:	J. Summers	Drive Weight:	140 lbs.
Location:	See Site Map	Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows* (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description	Penetrometer Reading (TSF)
						CH		Dark Brownish Grey Fat CLAY w/ Sand – very moist	
	T	3-10-22 (32)		12.5	116.3				> 4.5
						CL		Light Brown Lean CLAY w/ Sand – slightly moist to moist, hard, light brown mottling	
5	T	15-35-48 (84)				SM		Light Brown Silty SAND – slightly moist, very dense, light brown mottling	
10	T	5-15-29 (44)		14.7	109.5				> 4.5
						CL		Light Brownish Grey Lean CLAY w/ Sand – slightly moist, hard, white and brown mottling, charcoal specks	
15	S	1-8-11 (19)				SM		Light Brownish Grey and Light Brown Silty SAND – moist, medium dense	
20	T	1-7-9 (16)		5.3	90.7	SP-SM		Light Brown Poorly Graded SAND w/ Silt – dry to slightly moist, medium dense	
25	T	4-17-26 (45)				ML		Light Greyish Brown and Red Lean SILT w/ Sand – moist, hard, some fine tubular voids	> 4.5
						CL		Dark Reddish Brown Lean CLAY w/ Sand – moist, hard	
30	T	2-11-15 (26)		13.6	102.6	ML		Light Reddish Brown Lean SILT w/ Sand – slightly moist, hard, brown mottling	> 4.5
								Boring terminated at 30 feet No groundwater encountered	
35									

Material Description: This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log shows subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

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Sample Types
R - Ring Sample
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EXPLORATORY BORING LOG

Project:	Shasta Park Geotechnical Investigation	Drilling Equipment:	CME 75 – Hollow Stem Auger
Date Drilled:	1-26-2012 to 1-27-2012	Borehole Diameter:	8"
Logged By:	J. Summers	Drive Weight:	140 lbs.
Location:	See Site Map	Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows* (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description	Penetrometer Reading (TSF)
	T	2-5-7 (12)				CH		Dark Brownish Grey Fat CLAY w/ Sand – moist, very stiff	3.5
5	T	1-9-58/4"				CL		Light Brown Lean CLAY w/ Sand – slightly moist to moist, hard	>4.5
10	T	2-15-18 (33)		17.0	95.1	SM/ML		Light Brownish Grey Silty SAND to Sandy SILT – slightly moist, dense, streaks of white	4.5
15	T	1-7-15 (22)		22.4	95.5	ML		Light Reddish Brown Silty SAND – slightly moist to moist, medium dense, brown grey mottling	
20	T	1-6-16 (22)		24.7	95.4	SM		Light Greyish Brown Lean SILT w/ Sand – moist, hard, red mottling	4.5
25	T	3-14-21 (35)		24.4	97.7	ML		Light Greyish Brown and Red Lean CLAY w/ Sand – moist, hard Becoming more sandy and more red brown with depth	4.5
30	T	2-10-14 (24)				SM		Light Reddish Brown Silty SAND – moist, medium dense, contains indurated nodules	
35								Boring terminated at 30 feet No groundwater encountered	

Material Description: This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log shows subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

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O.D. = 2.5" I.D. = 2.0"

Sample Types
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- Groundwater
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EXPLORATORY BORING LOG

Project:	Shasta Park Geotechnical Investigation	Drilling Equipment:	CME 75 – Hollow Stem Auger
Date Drilled:	1-26-2012 to 1-27-2012	Borehole Diameter:	8"
Logged By:	J. Summers	Drive Weight:	140 lbs.
Location:	See Site Map	Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows* (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description	Penetrometer Reading (TSF)
	T	2-4-7 (11)				CH		Dark Brownish Grey Fat CLAY w/ Sand – moist, very stiff	3.5
5	T	5-20-50/4"				CL		Light Brown and Brown Lean CLAY w/ Sand – moist, hard, white streaks	>4.5
						ML		Light Brown Sand SILT – moist, hard	
10	T	5-17-15 (32)		7.6	105.5	SM		Brown Silty SAND – moist, medium dense	
15	T	5-7-11 (18)		30.9	86.7	ML		Light Greyish Brown Lean SILT w/ Sand – moist, hard, red mottling, fine tubular voids	4.5
20	T	14-27-39/5"							>4.5
25	T	6-10-18 (28)		31.4	83.6	CL		Dark Reddish Brown Lean CLAY w/ Sand – moist, hard	>4.5
30	T	9-13-19 (32)		13.9	99.9			Boring terminated at 30 feet No groundwater encountered	>4.5
35									

Material Description

This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log shows subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

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O.D. = 2.5" I.D. = 2.0"

Sample Types
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EXPLORATORY BORING LOG

Project:	Shasta Park Geotechnical Investigation	Drilling Equipment:	CME 75 – Hollow Stem Auger
Date Drilled:	1-26-2012 to 1-27-2012	Borehole Diameter:	8"
Logged By:	J. Summers	Drive Weight:	140 lbs.
Location:	See Site Map	Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows* (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description	Penetrometer Reading (TSF)
								Dark Brownish Grey Lean CLAY w/ Sand – very moist, hard	
	T	9-20-20 (40)		8.9	113.3				>4.5
5	T	50-50/5"						Light Brown and Brown Lean CLAY w/ Sand – moist, very hard	>4.5
						CL			
10	T	2-9-18 (27)						Light Greyish Brown Lean CLAY w/ Sand – trace angular gravel (up to ½")	4.25
15	T	12-25-35 (60)		15.0	102.4			Light Reddish Brown and Light Brown Lean CLAY w/ Sand	>4.5
						SM		Reddish Brown Silty SAND – moist, dense	
20	T	7-30-43 (73)				CL		Light Brown Lean CLAY – moist, hard, red mottling	>4.5
25	T	7-11-17 (28)		28.3	86.3	ML		Light Reddish Brown Lean SILT w/ Sand – moist, hard, fine tubular voids	>4.5
30	T	1-7-13 (20)		18.6	92.3			Boring terminated at 30 feet No groundwater encountered	>4.5
35									

This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log shows subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

*Note: All blow counts associated with a tube sampler are uncorrected. The sampler dimensions are as follows:
O.D. = 2.5" I.D. = 2.0"

Sample Types
R - Ring Sample
- Bulk Sample
- Groundwater
T - Tube Sample
S - SPT Sample
- End of Boring

EXPLORATORY BORING LOG

Project:	Shasta Park Geotechnical Investigation	Drilling Equipment:	CME 75 – Hollow Stem Auger
Date Drilled:	1-26-2012 to 1-27-2012	Borehole Diameter:	8"
Logged By:	J. Summers	Drive Weight:	140 lbs.
Location:	See Site Map	Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows* (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description	Penetrometer Reading (TSF)
						CH		Dark Brownish Grey Fat CLAY w Sand – moist, very stiff	
	T	5-6-30 (36)							3.5
						ML		Light Brownish Grey Lean SILT w/ Sand – moist, hard, some white streaks	>4.5
5	T	12-15-19 (34)				SM		Dark Brown Silty SAND – moist, medium dense	
						ML		Very Light Brown Lean SILT w/ Sand – moist, hard, reddish brown mottling	
10	T	11-36-43/5"						Boring terminated at 10 feet No groundwater encountered	>4.5
15									
20									
25									
30									
35									

Material Description: This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log shows subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

*Note: All blow counts associated with a tube sampler are uncorrected. The sampler dimensions are as follows:
O.D. = 2.5" I.D. = 2.0"

Sample Types
R - Ring Sample
- Bulk Sample
- Groundwater
T - Tube Sample
S - SPT Sample
- End of Boring

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BORING: B-7
SHEET: 1 of 1

EXPLORATORY BORING LOG

Project:	Shasta Park Geotechnical Investigation	Drilling Equipment:	CME 75 – Hollow Stem Auger
Date Drilled:	1-26-2012 to 1-27-2012	Borehole Diameter:	8"
Logged By:	J. Summers	Drive Weight:	140 lbs.
Location:	See Site Map	Drop:	30"

Depth (ft)	Samples: Sample Type	Samples: Blows* (blows/ft)	Samples: Bulk Sample	Moisture Content (%)	Dry Density (pcf)	USCS	Graphic Symbol	Material Description	Penetrometer Reading (TSF)
	T	6-10-12 (22)				CH		Dark Brownish Grey Fat CLAY w/ Sand – moist, hard	>4.5
5	T	17-38-50 (88)				CL		Brown Lean CLAY w/ Sand – slightly moist, hard, white streaks, red mottling, some indurated nodules	>4.5
10	T	6-7-9 (16)						Boring terminated at 10 feet No groundwater encountered	>4.5
15									
20									
25									
30									
35									

This log contains factual information and interpretation of the subsurface conditions between the samples. The stratum indicated on this log represent the approximate boundary between earth units and the transition may be gradual. The log shows subsurface conditions at the date and location indicated, and may not be representative of subsurface conditions at other locations and times.

*Note: All blow counts associated with a tube sampler are uncorrected. The sampler dimensions are as follows:
O.D. = 2.5" I.D. = 2.0"

Sample Types
R - Ring Sample
- Bulk Sample
- Groundwater
T - Tube Sample
S - SPT Sample
- End of Boring

APPENDIX B
RESULTS OF LABORATORY TESTS

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March 5, 2012

City of Sacramento, Department of Utilities
Attn: Gary Gulseth
1395 35th Avenue
Sacramento, CA 95822

Subject: **Preliminary Soils Tests Results**
Shasta Park Geotechnical Investigation Sacramento, CA

Mr. Gulseth,

Attached is a summary of test results performed on soils sampled by our representative for testing on January 26, 2012 and January 27, 2012 from the project site.

The tests were performed under the responsible charge of a Registered Civil Engineer in conformance with the following standard testing procedures:

ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 2166	Unconfined Compressive Strength of Cohesive Soils
ASTM D 2937	In-Situ Moisture and Density by Drive Cylinder
ASTM D 2844	Resistance R-Value and Expansion Pressure of Compacted Soils
ASTM D 1140	Amount of Materials in Soils Finer Than #200 Sieve
ASTM D 2435	One-Dimensional Consolidation Properties of Soils
CT 417	Soluble Sulfate Content of Soils
CT 422	Chloride Content of Soils
CT 643	Resistivity of pH of Soils

The laboratory test results are attached herein.

Respectfully submitted,

RMA Group, Inc.

Josh R. Summers, EIT
Staff Engineer

Reviewed by:

Simon Makdessi, PE, GE
Principal Engineer

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Sample Information

Sample Location	Sample Depth (ft)	Sample Type	Date Sampled	Tests Performed
Site	1 – 3	Bulk	1-27-2012	R-Value, Corrosivity Package
Site	3 – 5	Bulk	1-27-2012	Corrosivity Package
B-1	3	Tube	1-27-2012	Moisture/Density
B-1	6	Tube	1-27-2012	Moisture/Density
B-1	11	Tube	1-27-2012	Moisture/Density, #200 Wash
B-1	16	Tube	1-27-2012	Moisture/Density
B-1	21	Tube	1-27-2012	Consolidation
B-1	26	Tube	1-27-2012	Moisture/Density
B-1	31	Tube	1-27-2012	Moisture/Density
B-1	36	Tube	1-27-2012	Consolidation
B-1	41	Tube	1-27-2012	Moisture/Density
B-1	46	Tube	1-27-2012	Moisture/Density, #200 Wash
B-2	3	Tube	1-26-2012	Moisture/Density
B-2	6	Tube	1-26-2012	#200 Wash
B-2	11	Tube	1-26-2012	Moisture/Density
B-2	21	Tube	1-26-2012	Moisture/Density
B-2	31	Tube	1-26-2012	Moisture/Density
B-3	3	Tube	1-26-2012	Plasticity Index, Unconfined Compression
B-3	11	Tube	1-26-2012	Moisture/Density, Plasticity Index, #200 Wash
B-3	16	Tube	1-26-2012	Moisture/Density
B-3	21	Tube	1-26-2012	Moisture/Density
B-3	26	Tube	1-26-2012	Moisture/Density
B-4	3	Tube	1-26-2012	Unconfined Compression
B-4	11	Tube	1-26-2012	Moisture/Density
B-4	16	Tube	1-26-2012	Moisture/Density
B-4	26	Tube	1-26-2012	Moisture/Density
B-4	31	Tube	1-26-2012	Moisture/Density
B-5	3	Tube	1-26-2012	Moisture/Density, Plasticity Index
B-5	11	Tube	1-26-2012	Unconfined Compression
B-5	16	Tube	1-26-2012	Moisture/Density
B-5	26	Tube	1-26-2012	Moisture/Density
B-5	31	Tube	1-26-2012	Moisture/Density
B-6	6	Tube	1-26-2012	Corrosivity Package
B-7	3	Tube	1-26-2012	Corrosivity Package
B-7	6	Tube	1-26-2012	Corrosivity Package

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Test Results

In-Situ Moisture and Density by Drive Tube
ASTM D 2937

Sample Location	Sample Depth (ft)	Moisture (%)	Dry Density (pcf)
B-1	3	11.4 %	113.9 pcf
B-1	6	14.9 %	104.5 pcf
B-1	11	19.6 %	95.8 pcf
B-1	16	20.0 %	92.3 pcf
B-1	26	30.5 %	81.4 pcf
B-1	31	14.1 %	91.9 pcf
B-1	41	17.1 %	87.4 pcf
B-1	46	27.9 %	88.8 pcf
B-2	3	12.5 %	116.3 pcf
B-2	11	14.7 %	109.5 pcf
B-2	21	5.3 %	90.7 pcf
B-2	31	13.6 %	102.6 pcf
B-3	11	17.0 %	95.1 pcf
B-3	16	22.4 %	95.5 pcf
B-3	21	24.7 %	95.4 pcf
B-3	26	24.4 %	97.7 pcf
B-4	11	7.6 %	105.5 pcf
B-4	16	30.9 %	86.7 pcf
B-4	26	31.4 %	83.6 pcf
B-4	31	13.9 %	99.9 pcf
B-5	3	8.9 %	113.3 pcf
B-5	16	15.0 %	102.4 pcf
B-5	26	28.3 %	86.3 pcf
B-5	31	18.6 %	92.3 pcf

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Resistance R-Value and Expansion Pressure of Compacted Soils
ASTM D 2844

Sample Location	Sample Depth (ft)	R-Value	Remarks
Site	1 – 3	<5	Extruded

Amount of Materials in Soils Finer Than #200 Sieve
ASTM D 1140

Sample Location	Sample Depth (ft)	% Passing #200 Sieve
B-1	11 ft	57.4 %
B-1	46 ft	37.1 %
B-2	6 ft	36.9 %
B-3	11 ft	49.2 %

Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4318

Sample Location	Sample Depth (ft)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)
B-3	3 ft	63	19	44
B-3	11 ft	36	27	9
B-5	3 ft	31	18	13

Unconfined Compressive Strength of Cohesive Soils
ASTM D 2166

Sample Location	Sample Depth (ft)	Unconfined Compressive Strength (psf)
B-3	3 ft	7174 psf
B-4	3 ft	4075 psf
B-5	11 ft	3094 psf

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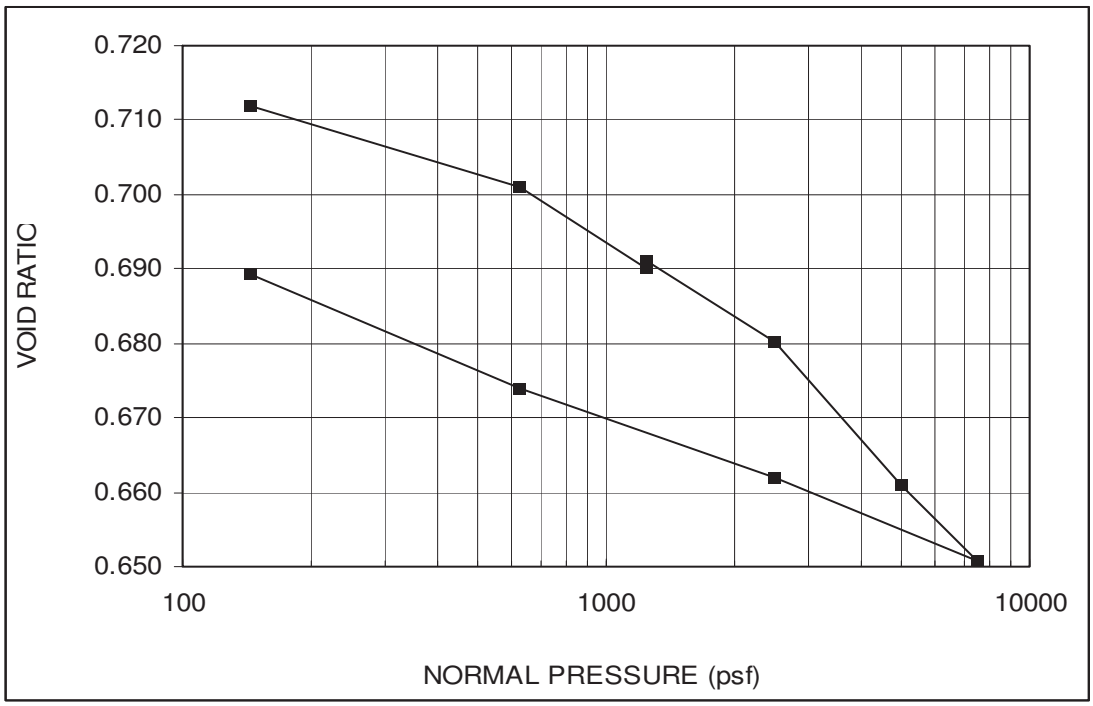
One-Dimensional Consolidation Properties of Soils
ASTM D 2435

Location: B-1@ 36 ft

Unit Weight (pcf):	96.3	Initial Dial Reading:	0.0050	inch
Initial Moisture:	24.5%	Initial Specimen Height:	1.0000	inch
Final Moisture:	30.1%	Initial Void Ratio:	0.717	
Initial Saturation:	90.5%	Final Void Ratio:	0.689	
Final Saturation:	115.7%	Specific Gravity :	2.65	

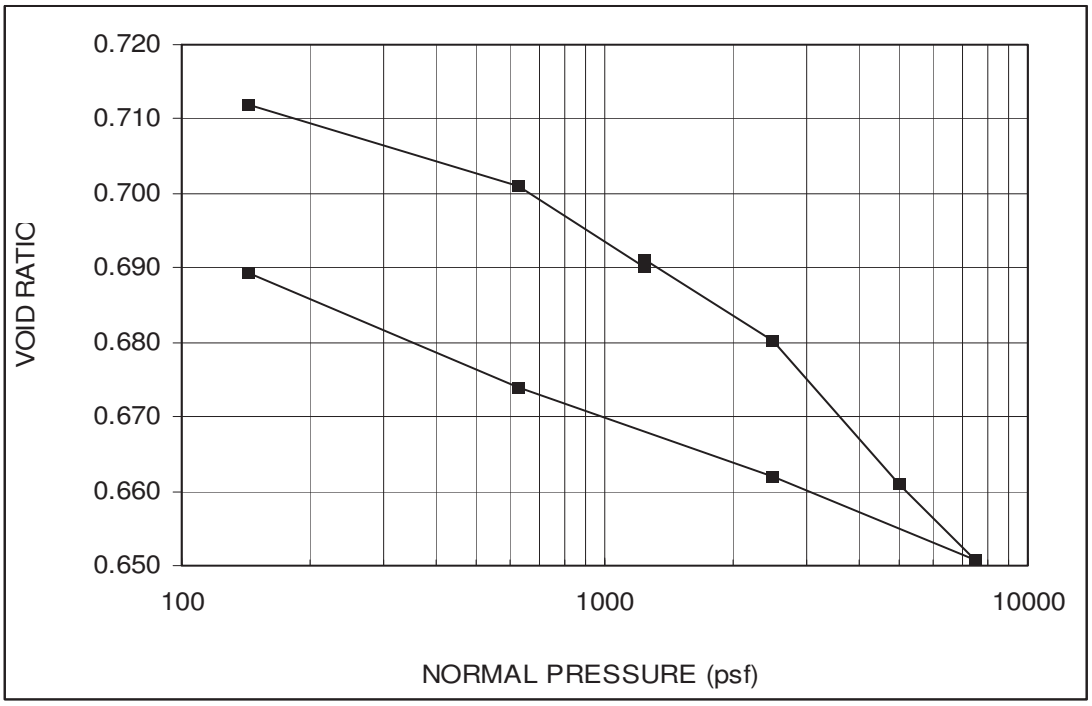
Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.0080	0.9970	0.712
	625	0.0144	0.9906	0.701
	1250	0.0207	0.9843	0.690
Add water	1250	0.0201	0.9849	0.691
	2500	0.0265	0.9785	0.680
	5000	0.0378	0.9672	0.661
	7500	0.0437	0.9613	0.651
	2500	0.0371	0.9679	0.662
	625	0.0302	0.9748	0.674
	144	0.0212	0.9838	0.689



Location: B-1@ 36 ft

Unit Weight (pcf):	96.3	Initial Dial Reading:	0.0050	inch
Initial Moisture:	24.5%	Initial Specimen Height:	1.0000	inch
Final Moisture:	30.1%	Initial Void Ratio:	0.717	
Initial Saturation:	90.5%	Final Void Ratio:	0.689	
Final Saturation:	115.7%	Specific Gravity :	2.65	

Moisture Condition	Load (psf)	Final Dial Reading (inches)	Sample Height (inches)	Void Ratio
In Situ	144	0.0080	0.9970	0.712
	625	0.0144	0.9906	0.701
	1250	0.0207	0.9843	0.690
Add water	1250	0.0201	0.9849	0.691
	2500	0.0265	0.9785	0.680
	5000	0.0378	0.9672	0.661
	7500	0.0437	0.9613	0.651
	2500	0.0371	0.9679	0.662
	625	0.0302	0.9748	0.674
	144	0.0212	0.9838	0.689



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25712 Commercentre Drive
Lake Forest, California 92630
949.297.5020 Phone
949.297.5027 Fax

13 February 2012

Simon Makdessi, PE, GE
RMA Group of Northern California
3150 Fitzerald Road
Rancho Cordova, CA 95742

RE: Shasta Park Geotechnical Investigation

Enclosed are the results of analyses for samples received by the laboratory on 02/04/12 08:53. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Wendy Hsiao
Project Manager

SunStar Laboratories, Inc.
PROVIDING QUALITY ANALYTICAL SERVICES NATIONWIDE

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Lake Forest, California 92630
949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
site 1-3 bulk	T120196-01	Soil	02/03/12 00:00	02/04/12 08:53
site 3-5 bulk	T120196-02	Soil	02/03/12 00:00	02/04/12 08:53
B-6 6 tube	T120196-03	Soil	02/03/12 00:00	02/04/12 08:53
B-7 3 tube	T120196-04	Soil	02/03/12 00:00	02/04/12 08:53
B-7 6 tube	T120196-05	Soil	02/03/12 00:00	02/04/12 08:53

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Wendy Hsiao

Wendy Hsiao, Project Manager

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Lake Forest, California 92630
949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

site 1-3 bulk

T120196-01 (Soil)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SunStar Laboratories, Inc.									
Conventional Chemistry Parameters by APHA/EPA/ASTM Methods									
pH	**6.2**	0.1	pH Units	1	2020625	02/06/12	02/07/12	EPA 9045B	
Miscellaneous Physical/Conventional Chemistry Parameters									
Resistivity	**7800**	100	ohmcm	1	2020633	02/06/12	02/07/12	SM2510b/12 0.1	
Anion Scan by EPA Method 300.0									
Chloride	**3.87**	2.00	mg/kg	1	2020713	02/07/12	02/08/12	EPA 300.0	
Sulfate as SO4	**4.07**	2.00	"	"	"	"	"	"	

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Lake Forest, California 92630
949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

site 3-5 bulk

T120196-02 (Soil)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SunStar Laboratories, Inc.									
Conventional Chemistry Parameters by APHA/EPA/ASTM Methods									
pH	**8.4**	0.1	pH Units	1	2020625	02/06/12	02/07/12	EPA 9045B	
Miscellaneous Physical/Conventional Chemistry Parameters									
Resistivity	**1400**	100	ohmcm	1	2020633	02/06/12	02/07/12	SM2510b/12 0.1	
Anion Scan by EPA Method 300.0									
Chloride	**183**	2.00	mg/kg	1	2020713	02/07/12	02/08/12	EPA 300.0	
Sulfate as SO4	**40.1**	2.00	"	"	"	"	"	"	

SunStar Laboratories, Inc.

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Wendy Hsiao, Project Manager

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949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

B-6 6 tube

T120196-03 (Soil)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SunStar Laboratories, Inc.									
Conventional Chemistry Parameters by APHA/EPA/ASTM Methods									
pH	**8.3**	0.1	pH Units	1	2020625	02/06/12	02/07/12	EPA 9045B	
Miscellaneous Physical/Conventional Chemistry Parameters									
Resistivity	**2100**	100	ohmcm	1	2020633	02/06/12	02/07/12	SM2510b/12 0.1	
Anion Scan by EPA Method 300.0									
Chloride	**136**	2.00	mg/kg	1	2020713	02/07/12	02/08/12	EPA 300.0	
Sulfate as SO4	**2.99**	2.00	"	"	"	"	"	"	

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Wendy Hsiao, Project Manager

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949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

B-7 3 tube

T120196-04 (Soil)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SunStar Laboratories, Inc.									
Conventional Chemistry Parameters by APHA/EPA/ASTM Methods									
pH	**8.4**	0.1	pH Units	1	2020625	02/06/12	02/07/12	EPA 9045B	
Miscellaneous Physical/Conventional Chemistry Parameters									
Resistivity	**3400**	100	ohmcm	1	2020633	02/06/12	02/07/12	SM2510b/12 0.1	
Anion Scan by EPA Method 300.0									
Chloride	**4.71**	2.00	mg/kg	1	2020713	02/07/12	02/08/12	EPA 300.0	
Sulfate as SO4	**13.9**	2.00	"	"	"	"	"	"	

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Wendy Hsiao, Project Manager

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Lake Forest, California 92630
949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

B-7 6 tube

T120196-05 (Soil)

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
SunStar Laboratories, Inc.									
Conventional Chemistry Parameters by APHA/EPA/ASTM Methods									
pH	**8.5**	0.1	pH Units	1	2020625	02/06/12	02/07/12	EPA 9045B	
Miscellaneous Physical/Conventional Chemistry Parameters									
Resistivity	**2100**	100	ohmcm	1	2020633	02/06/12	02/07/12	SM2510b/12 0.1	
Anion Scan by EPA Method 300.0									
Chloride	**46.2**	2.00	mg/kg	1	2020713	02/07/12	02/08/12	EPA 300.0	
Sulfate as SO4	**65.8**	2.00	"	"	"	"	"	"	

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Wendy Hsiao, Project Manager

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Lake Forest, California 92630
949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

Conventional Chemistry Parameters by APHA/EPA/ASTM Methods - Quality Control

SunStar Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2020625 - General Preparation										
Duplicate (2020625-DUP1)		**Source: T120196-01**		Prepared: 02/06/12	Analyzed: 02/07/12					
pH	6.20	0.1	pH Units		6.15			0.810	20	

SunStar Laboratories, Inc.

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Wendy Hsiao, Project Manager

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949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

Miscellaneous Physical/Conventional Chemistry Parameters - Quality Control

SunStar Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2020633 - General Preparation										
Duplicate (2020633-DUP1)		**Source: T120196-01**		Prepared: 02/06/12	Analyzed: 02/07/12					
Resistivity	7180	100	ohmcm		7780			7.92	15	

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Wendy Hsiao, Project Manager

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Lake Forest, California 92630
949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

Anion Scan by EPA Method 300.0 - Quality Control

SunStar Laboratories, Inc.

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 2020713 - General Preparation										
Blank (2020713-BLK1)				Prepared: 02/07/12	Analyzed: 02/08/12					
Chloride	ND	2.00	mg/kg							
Sulfate as SO4	ND	2.00	"							
LCS (2020713-BS1)				Prepared: 02/07/12	Analyzed: 02/08/12					
Chloride	94.0	2.00	mg/kg	100		94.0	80-120			
Sulfate as SO4	99.3	2.00	"	100		99.3	80-120			
Matrix Spike (2020713-MS1)		**Source: T120190-01**		Prepared: 02/07/12	Analyzed: 02/08/12					
Chloride	91.9	2.00	mg/kg	100	2.87	89.0	70-130			
Sulfate as SO4	89.8	2.00	"	100	6.42	83.4	70-130			
Matrix Spike Dup (2020713-MSD1)		**Source: T120190-01**		Prepared: 02/07/12	Analyzed: 02/08/12					
Chloride	93.2	2.00	mg/kg	100	2.87	90.3	70-130	1.38	20	
Sulfate as SO4	91.1	2.00	"	100	6.42	84.7	70-130	1.40	20	

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The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.

Wendy Hsiao, Project Manager

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25712 Commercentre Drive
Lake Forest, California 92630
949.297.5020 Phone
949.297.5027 Fax

RMA Group of Northern California	Project:	Shasta Park Geotechnical Investigation	
3150 Fitzerald Road	Project Number:	11-975-01	**Reported:**
Rancho Cordova CA, 95742	Project Manager:	Simon Makdessi, PE, GE	02/13/12 15:00

Notes and Definitions

DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

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Wendy Hsiao, Project Manager

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T120196

Engineering Test Request

Project Name:	Shasta Park Geotech Investigation	**Project Number:**	11-975-01
Client Name:	City of Sacramento, DOU	**Date Requested:**	1/30/2012
Test Requested By:	G. Gulseth	**Sheet** 1 **of** 3	***Task #:*** 04
Requested Completion Date*:		01-Environmental; 03-Geologic; 04-Geotechnical Investigation; 06-Mass Grade; 07-U-ground; 08-Street; 09-Foundation; 10-Consult.	

	Borehole No.	Sample Depth, (ft.)	Sample Type	Moisture Density	Water Content	Plasticity Index	Specific Gravity	Long Hydrometer, ASTM	Short Hydrometer, CA	Wet Sieve to #200	Sieve Analysis	Swell	Direct Shear (kips/s.f.) Normal Pressure 1	2	3		Unconfined Compression	Triaxial Compression	Consolidation Max. Load, (kips)	Unloading, (check)	Saturate at (kips)	Compaction Curve ASTM D1557 Method "A"(#4)	Method "B"(3/8)	Method "C"(3/4)	Check Point	CA Impact 216	R-Value	Water Soluble Sulfate	Corrosivity Testing		Remarks Additional Tests Requested
01	SITE	1-3	BULK																												
02	SITE	3-5	BULK																								X		X		
	B-1	3	TUBE	X																									X		
	B-1	6	TUBE	X																											
	B-1	11	TUBE	X						X																					
	B-1	16	TUBE																												
	B-1	21	TUBE																X												
	B-1	26	TUBE	X																											
	B-1	31	TUBE	X																											
	B-1	36	TUBE																X												
	B-1	41	TUBE	X																											
	B-1	46	TUBE	X						X																					
	B-1	51	TUBE																												
	B-1	56	TUBE																												
	B-2	3	TUBE	X																											
	B-2	6	TUBE							X																					
	B-2	11	TUBE	X																											
	B-2	16	BAG																												
	B-2	21	TUBE	X																											
	B-2	[illegible]	TUBE																												
	[illegible]	31	TUBE	X																											
	TOTALS																														

Standard Turnaround or RUSH Priority*

Additional Charges (Hrs. or Flat Fee)

Project Engineer's Approval (Sign & Date)

* Please check with the Lab for deadline availability. All RUSH testing is subject to the Lab's approval.
Test items requested as RUSH may be subject to RUSH Charges.
RUSH Request MUST be signed by the Project Engineer with the approved additional RUSH Charges.

Notes/Comments:

2-3-12 1155

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Control Number:

Date Received: 2-4-12

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Laboratory Number:

Date Completed:

TEMP 4.2

STD. TAT

BC

2-4-12

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T120196

Engineering Test Request

Project Name:	Shasta Park Geotech Investigation	**Project Number:**	11-975-01
Client Name:	City of Sacramento, DOU	**Date Requested:**	1/30/2012
Test Requested By:	G. Gulseth	**Sheet** 2 **of** 3	***Task #:*** 04
Requested Completion Date*:		01-Environmental; 03-Geologic; 04-Geotechnical Investigation; 06-Mass Grade; 07-U-ground; 08-Street; 09-Foundation; 10-Consult.	

Borehole No.	Sample Depth, (ft.)	Sample Type	Moisture Density	Water Content	Plasticity Index	Specific Gravity	Long Hydrometer, ASTM	Short Hydrometer, CA	Wet Sieve to #200	Sieve Analysis	Swell	Direct Shear (kips/s.f.) Normal Pressure 1	2	3		Unconfined Compression	Triaxial Compression	Consolidation Max. Load, (kips)	Unloading, (check)	Saturate at (kips)	Compaction Curve ASTM D1557 Method "A"(#4)	Method "B"(3/8)	Method "C"(3/4)	Check Point	CA Impact 216	R-Value	Water Soluble Sulfate	Corrosivity Testing		Remarks Additional Tests Requested
	3	TUBE			X											X														
B-3		TUBE																												
B-3	11	TUBE	X		X				X																					
B-3	16	TUBE	X																											
B-3	21	TUBE	X																											
B-3	26	TUBE	X																											
B-3	31	TUBE																												
B-4	3'	TUBE														X														
B-4	6	TUBE																												
B-4	11	TUBE	X																											
B-4	16	TUBE	X																											
B-4	21	TUBE																												
B-4	26	TUBE	X																											
B-4	31	TUBE	X																											
B-5	3	TUBE	X		X																									
B-5	6.	TUBE																												
B-5	11	TUBE														X														
B-5	16	TUBE	X																											
B-5	21	TUBE																												
B-5	26	TUBE	X																											
B-5	31	TUBE	X																											
TOTALS			14		3				4							3		2							1		5			

Standard Turnaround or RUSH Priority*

Additional Charges (Hrs. or Flat Fee)

Project Engineer's Approval (Sign & Date)

* Please check with the Lab for deadline availability. All RUSH testing is subject to the Lab's approval.
Test items requested as RUSH may be subject to RUSH Charges.
RUSH Request MUST be signed by the Project Engineer with the approved additional RUSH Charges.

Notes/Comments:

1155

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Control Number:

Date Received: 2.9.12

Received By:

Laboratory Number:

Date Completed:

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BC

2.9.12

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T120196

Engineering Test Request

Project Name:	Shasta Park Geotech Investigation	**Project Number:**	11-975-01
Client Name:	City of Sacramento, DOU	**Date Requested:**	1/30/2012
Test Requested By:	G. Gulseth	**Sheet** 3 of 3	***Task #:*** 04
Requested Completion Date*:		01-Environmental; 03-Geologic; 04-Geotechnical Investigation; 06-Mass Grade; 07-U-ground; 08-Street; 09-Foundation; 10-Consult.	

Borehole No.	Sample Depth, (ft.)	Sample Type	Moisture Density	Water Content	Plasticity Index	Specific Gravity	Long Hydrometer, ASTM	Short Hydrometer, CA	Wet Sieve to #200	Sieve Analysis	Swell	Direct Shear (kips/s.f.) Normal Pressure 1	2	3		Unconfined Compression	Triaxal Compression	Consolidation Max. Load, (kips)	Unloading, (check)	Saturate at (kips)	Compaction Curve ASTM D1557 Method "A"(#4)	Method "B"(3/8)	Method "C"(3/4)	Check Point	CA Impact 216	R-Value	Water Soluble Sulfate	Corrosivity Testing		Remarks Additional Tests Requested
[redacted]																															
B-6	6	TUBE																										X			
[redacted]																															
B-7	3	TUBE																										X			
B-7	6	TUBE																										X			
[redacted]																															
TOTALS																															

Standard Turnaround or RUSH Priority*

Additional Charges (Hrs. or Flat Fee)

Project Engineer's Approval (Sign & Date)

* Please check with the Lab for deadline availability. All RUSH testing is subject to the Lab's approval.
Test items requested as RUSH may be subject to RUSH Charges.
RUSH Request MUST be signed by the Project Engineer with the approved additional RUSH Charges.

Notes/Comments:

2-3-12

FOR LAB USE ONLY

Control Number:

Date Received: 2-4-12

Received By:

Laboratory Number:

Date Completed:

STD. TAT

2-4-12

SunStar Laboratories, Inc.
PROVIDING QUALITY ANALYTICAL SERVICES NATIONWIDE

SAMPLE RECEIVING REVIEW SHEET

BATCH # T120196

Client Name: RMA GROUP

Project: SHASTA PARK GEOTECH INVESTIGATION

Received by: BRIAN

Date/Time Received: 2/4/12 8:53

Delivered by : ☐ Client ☐ SunStar Courier ☒ GSO ☐ FedEx ☐ Other

Total number of coolers received 1

Temp criteria = 6°C > 0°C (no frozen containers)

Temperature: cooler #1 4.4 °C +/- the CF (- 0.2°C) = 4.2 °C corrected temperature

cooler #2 _____ °C +/- the CF (- 0.2°C) = _____ °C corrected temperature

cooler #3 _____ °C +/- the CF (- 0.2°C) = _____ °C corrected temperature

Samples outside temp. but received on ice, w/in 6 hours of final sampling.	☒ Yes	☐ No*	☐ N/A
Custody Seals Intact on Cooler/Sample	☒ Yes	☐ No*	☐ N/A
Sample Containers Intact	☒ Yes	☐ No*	
Sample labels match COC ID's	☒ Yes	☐ No*	
Total number of containers received match COC	☒ Yes	☐ No*	
Proper containers received for analyses requested on COC	☒ Yes	☐ No*	
Proper preservative indicated on COC/containers for analyses requested	☐ Yes	☐ No*	☒ N/A

Complete shipment received in good condition with correct temperatures, containers, labels, volumes preservatives and within method specified holding times. ☒ **Yes** ☐ **No***

* Complete Non-Conformance Receiving Sheet if checked

Cooler/Sample Review - Initials and date BC 2.4.12

Comments:

APPENDIX C
SITE SPECIFIC SEISMIC DESIGN CRITERIA

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GEOTECHNICAL CONSULTANTS

SHASTA PARK WATER STORAGE TANK PROJECT
SOUTH OF KASTANIS WAY
NORTH OF IMAGINATION PARKWAY EXTENDED
SACRAMENTO, CA

for

City of Sacramento Department of Utilities
Engineering Services Division
1395 35th Avenue
Sacramento, CA 95822

April 18, 2012

11-975-01

April 18, 2012

City of Sacramento Department of Utilities
Engineering Services Division
1395 35th Avenue
Sacramento, CA 95822

Attention: Gary Gulseth, P.E., G.E., Senior Engineer

Subject: Shasta Park Water Storage Tank Project
South of Kastanis Way
North of Imagination Parkway Extended
Sacramento, CA

Mr. Gulseth:

In accordance with your request and authorization, we have performed a seismic hazard analysis for the subject project to develop site-specific seismic design criteria for the subject project. At your request, our analyses have utilized design criteria specified in the American Water Works Association (AWWA) Standard D110-04 and the 2009 International Building Code (IBC-09). The seismic design provisions of AWWA D110-04 were written to conform to the 1994 Uniform Building Code and an alternative seismic design method based on requirements of the 1997 Uniform Building Code. The 2009 International Building Code seismic design procedures are based upon methodologies contained in an American Society of Civil Engineers/Structural Engineering Institute document entitled *Minimum Design Loads for Buildings and other Structures* (ASCE/SEI 7-05). We have used the methodologies contained in these documents to evaluate the following earthquake probability scenarios that you have requested:

- 2% probability of exceedance in 50 years
- 10% probability of exceedance in 50 years
- 10% probability of exceedance in 100 years

1.00 GENERAL AND SITE-SPECIFIC SEISMIC DESIGN PARAMETERS 2% IN 50 YEARS (IBC – 09, ASCE/SEI 7-05)

1.01 General Seismic Ground Motion Values

Mapped IBC-09 seismic design parameters have been developed in using the online U.S. Geological Survey Java Ground Motion Parameter Calculator (Version 5.0.10, ASCE 7 Standard) and the ASCE/SEI 7-05. The calculator generates probabilistic and deterministic maximum considered earthquake (MCE) spectral parameters represented by a 5-percent damped acceleration response spectrum having a 2-percent probability of exceedance in 50 years. The deterministic MCE response accelerations are calculated as 150 percent of the largest median 5-percent damped spectral response acceleration computed on active faults within a region, where the deterministic values govern. The calculator does not, however, produce separate probabilistic and deterministic results. Using a site location of latitude = 38.453º and longitude -121.4142º and soil data from borings drilled at the site, the following values were generated:

Table 1: USGS Java Ground Motion Calculator Parameters and Values

Parameter	Value
Site Class	D
Soil Profile Name	Stiff soil profile
Mapped Spectral Acceleration at 0.2- second, S_s	0.593 g
Mapped Spectral Acceleration at 1- second, S_1	0.241 g
Site Coefficient, F_a	1.326
Site Coefficient, F_v	1.918
MCE Spectral Acceleration at 0.2- second period, S_{MS}	0.786 g
MCE Spectral Acceleration at 1-second period, S_{M1}	0.462 g
DE Spectral Acceleration at 0.2- second period), S_{DS}	0.524 g
DE Spectral Acceleration at 1-second period, S_{D1}	0.308 g
Control Period, T_0	0.118 sec.
Control Period T_S	0.588 sec.

Seismic design values generated for ASCE/SEI 7-05 parameters are presented below in Table 2.

Table 2: ASCE/SEI 7-05 Seismic Parameters and Values

Parameter	Value
Occupancy Category (ASCE/SEI 7-05 Table 1-1)	IV
AWWA Seismic Use Group*	IIIE
Site Class (ASCE/SEI 7-05 Table 20.3-1)	D (Stiff soil profile)
Seismic Design Category (ASCE/SEI 7-05 Tables 11.6.1 & 11.6.2)	D
Mapped Spectral Acceleration, 5% damped at short (0.2 sec. period), S_s (ASCE/SEI Figure 22-3 and USGS Calculator)	0.593g
Mapped Spectral Acceleration, 5% damped at one second period, S_1 (ASCE/SEI Figure 22-4 and USGS Calculator)	0.241g
Importance factor I (ASCE/SEI Table 11.5-1)	1.5
Long Period Transition Period, TL (ASCE/SEI Table 11.5-1)	12 seconds

*The term "Seismic Use Group" was omitted from the 2009 IBC and replace with the term "Occupancy Category"

1.02 Site-Specific Seismic Hazards Analysis

Site-specific seismic design parameters including acceleration response spectra were developed based on the method described in Chapter 21, Section 21.2 of ASCE 7-05. A five step procedure, as described below, was followed.

The following procedure was followed in evaluating the site-specific seismic design parameters in accordance with ASCE 7-05:

Step 1: Evaluate Probabilistic MCE Spectrum (ASCE 7-05 Section 21.2.1)

Probabilistic spectral response accelerations were evaluated using the computer program EZ-FRISK Version 7.62 Build 001 (Risk Engineering, 2011). Next-generation attenuation (NGA) relationships developed by Boore-Atkinson (2008), Campbell-Bozorgnia (2008) and Chiou-Youngs (2008) were selected for our analysis, similar to the ones used in the current USGS seismic hazards maps. Input parameters included: site coordinates (latitude = 38.453º, longitude = -121.4142º; soil site conditions (estimated shear wave velocity in the upper 30 meters, Vs_{30} = 246 m/sec, which corresponds to Site Class D); a fault search radius of 100 km; 2% probability of exceedance (PE) in 50 years, which corresponds to a return period of 2,475 years; 5% damping; and fault data based on a California Geological Survey/U.S. Geological Survey (CGS/USGS) fault model and a maximum rotated component near-source directivity factor (Huang and others, 2008).

Results of the probabilistic seismic hazard analysis are presented in Table 3 and Figure 1.

Step 2: Evaluate Deterministic MCE Spectrum (ASCE 7-05 Section 21.2.2)

Deterministic spectral response accelerations were evaluated using the same attenuation relationships and parameters used for the probabilistic analysis. Deterministic MCE response accelerations computed using NGA relations were calculated using 150% of the median values of the 5%-damped spectral response acceleration. In addition, a deterministic lower limit MCE response spectrum was calculated using equations from Figure 21.2-1 on page 207 of ASCE7-05.

Results of the deterministic seismic hazard analysis are presented in Table 3 and Figure 1.

Step 3: Evaluate Site-Specific MCE Spectrum (ASCE 7-05 Section 21.2.3)

Page 207 of ASCE 7-05 states the following:

> "The site-specific MCE spectral response acceleration at any period S_{aM} shall be taken as the lesser of the spectral accelerations from the probabilistic MCE of Section 21.2.1 and the deterministic MCE of Section 21.2.2."

The site-specific MCE spectral response accelerations are presented in Table 3 and Figure 1.

Step 4: Evaluate Design Earthquake (DE) Response Spectrum (ASCE 7-05 Section 21.3)

Page 208 of ASCE 7-05 states that the design spectral response acceleration at any period shall be determined from the equation: $S_a = ⅔\ S_{aM}$, where S_{aM} is the MCE spectral response acceleration obtained from Section 21.1 or 21.2. ASCE 7-05 also states that the design spectral response acceleration at any period shall not be less than 80% of the general acceleration response spectrum, S_a, determined in accordance with Section 11.4.5 (Figure 11.4-1). Please note that, for the subject site, the long-period transition (T_L from ASCE 7-05 Figure 22-15) equals 12 seconds, and therefore, the equation on the right side of the figure is not applicable.

The values for ⅔ of the site-specific MCE spectrum and 80% of S_a of Section 11.4.5 values are presented in Table 3 and Figure 3. Site-specific DE spectral response accelerations are presented in Table 3 and Figure 4.

Step 5: Evaluate Site-Specific Seismic Design Parameters (ASCE 7-05 Section 21.4)

Page 208 of ASCE 7-05 states:

> "…the parameter S_{DS} shall be taken as the spectral acceleration, S_a, obtained from the site-specific spectra at a period of 0.2 second, except that it shall not be taken as less than 90% of the peak spectral acceleration, S_a, at any period larger than 0.2 second. The parameter S_{D1} shall be taken as the greater of the spectral acceleration, S_a, at a period of 1 second or two times the spectral acceleration, S_a, at a period of 2 seconds. The parameters S_{MS} and S_{M1} shall be taken as 1.5 times S_{DS} and S_{D1}, respectively. The values so obtained shall not be less than 80 percent of the values determined in accordance with Section 11.4.3 for S_{MS} and S_{M1} and Section 11.4.4 for S_{DS} and S_{D1}."

The recommended site-specific seismic design parameters for both MCE and DE events are presented in Table 4.

Comparison of general and site-specific spectra values are presented in Table 5.

Table 3: Development of Sit-Specific Acceleration Spectra, Sa (g), Based on ASCE 7-05

Period T (sec)	Probabilistic MCE Spectrum 2% PE in 50 yrs (21.2.1)	Deterministic Spectrum 150% of Median (21.2.2)	Deterministic Lower Limit (21.2.1)	2/3 of Site-Specific MCE Spectrum (21.3)	General DE Spectrum Section (11.4.5)	80% of General DE Spectrum (11.4.5)	Site-Specific MCE Spectrum (21.2.3)	Site-Specific DE Spectrum (21.3)
	Figure 1			Figure 2			Figure 3	Figure 4
0.00	0.378	0.768	1.989	0.252	0.210	0.168	0.378	0.252
0.05	0.436	0.890	1.989	0.291	0.343	0.275	0.436	0.291
0.10	0.622	1.154	1.989	0.415	0.477	0.382	0.622	0.415
0.20	0.819	1.523	1.989	0.546	0.524	0.419	0.819	0.546
0.25	0.823	1.605	1.989	0.549	0.524	0.419	0.823	0.549
0.30	0.824	1.628	1.989	0.549	0.524	0.419	0.824	0.549
0.40	0.769	1.700	1.989	0.513	0.524	0.419	0.769	0.513
0.50	0.744	1.710	1.989	0.496	0.524	0.419	0.744	0.496
0.75	0.636	1.505	1.534	0.424	0.411	0.329	0.636	0.424
1.00	0.536	1.261	1.151	0.357	0.308	0.246	0.536	0.357
1.50	0.397	0.847	0.767	0.264	0.205	0.164	0.397	0.264
2.00	0.305	0.622	0.575	0.203	0.154	0.123	0.305	0.203
3.00	0.204	0.397	0.384	0.136	0.103	0.082	0.204	0.136
4.00	0.149	0.286	0.288	0.099	0.077	0.062	0.149	0.099
5.00	0.125	0.213	0.230	0.083	0.062	0.049	0.125	0.083
7.50	0.083	0.105	1.153	0.056	0.041	0.033	0.083	0.056
10.00	0.057	0.055	0.115	0.038	0.031	0.025	0.057	0.038

Table 4: Recommended Site-Specific Seismic Design Parameters Based on ASCE 7-05

Parameter	MCE Spectrum	DE Spectrum
Peak Ground Acceleration, PGA (g)	PGA = 0.378	PGA = 0.252
Spectral Acceleration at T=0.2 sec (g)	S_{MS} = 0.819	S_{DS} = 0.546
Spectral Acceleration at T=1.0 sec (g)	S_{M1} = 0.610	S_{D1} = 0.407
Control Period, T_0 (sec)	T_0 = 0.149	T_0 = 0.149
Control Period, T_S (sec)	T_S = 0.745	T_S = 0.745

Figure 1: Site-Specific Probabilistic and Deterministic Spectra

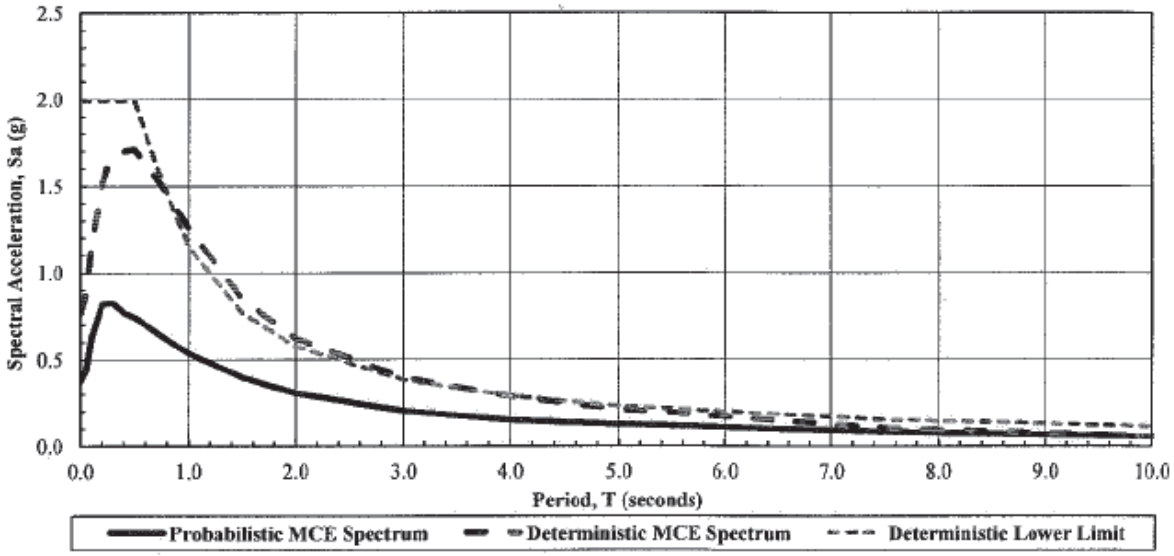


Figure 2: 2/3 of Site-Specific MCE Spectrum and 80% of the General DE Spectrum

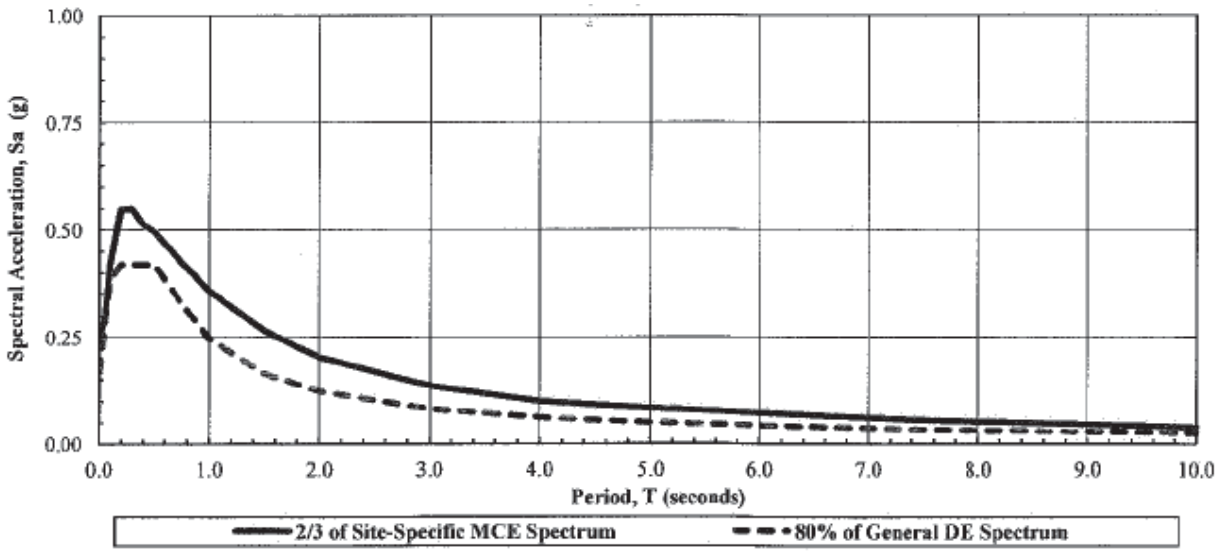


Figure 3: Site-Specific Maximum Considered Earthquake (MCE) Spectrum

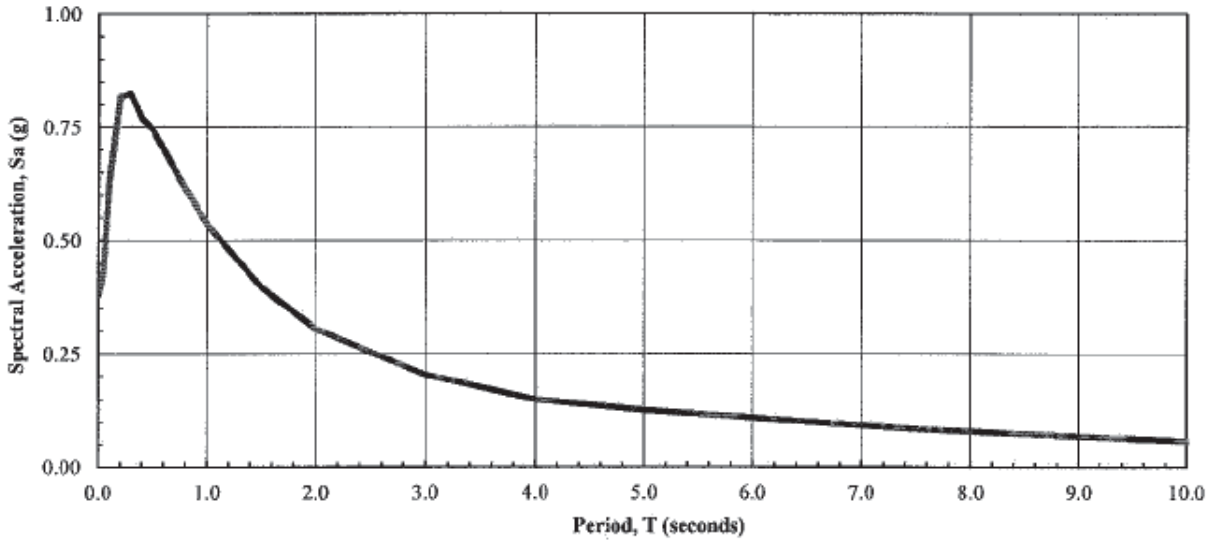


Figure 4: Site-Specific Design Earthquake (DE) Spectrum

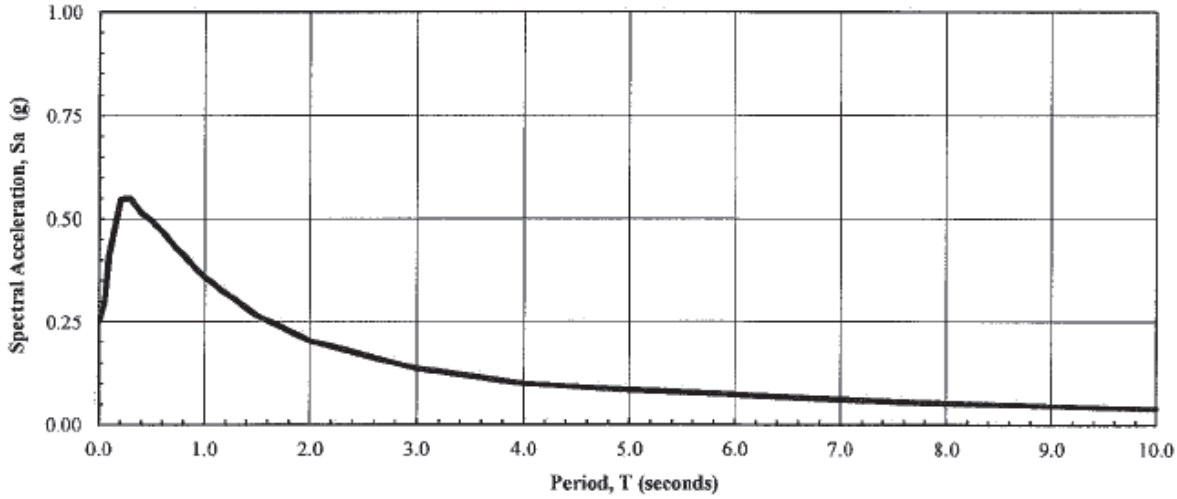


Table 5 - Comparison of ASCE/SEI 7-05 General and Site-Specific Acceleration Spectra

Period T (sec)	ASCE/SEI 7-05 General Acc. Spectra, Sa (g)		ACES/SEI Site-Specific Acc. Spectra, Sa (g)	
	MCE	DE	MCE	DE
0.000	0.314	0.210	0.378	0.252
0.050	0.515	0.343	0.436	0.291
0.100	0.716	0.477	0.622	0.415
0.200	0.786	0.524	0.819	0.546
0.250	0.786	0.524	0.823	0.549
0.300	0.786	0.524	0.824	0.549
0.400	0.786	0.524	0.709	0.513
0.500	0.786	0.524	0.744	0.496
0.750	0.616	0.411	0.636	0.424
1.000	0.462	0.308	0.536	0.357
1.500	0.308	0.205	0.397	0.264
2.000	0.231	0.154	0.305	0.203
3.000	0.154	0.103	0.204	0.136
4.000	0.116	0.077	0.149	0.099
5.000	0.092	0.062	0.125	0.083
7.500	0.062	0.041	0.083	0.056
10.000	0.046	0.031	0.057	0.038

2.00 MAPPED AND SITE-SPECIFIC SEISMIC DESIGN PARAMETERS 10% IN 50 YEARS AND 100 YEARS (IBC – 09, ASCE/SEI 7-05, AWWA D110-04)

In accordance with the requested scope of work, seismic hazards analyses were conducted to evaluate site-specific probabilistic seismic response spectra for two seismic design events given below:

- 10% probability of exceedance (PE) in 50 years, which is equivalent to an average return period (ARP) of 475 years.
- 10% probability of exceedance (PE) in 100 years, which is equivalent to an average return period (ARP) of 950 years.

2.01 Mapped Seismic Ground Motion Values

Provisions for earthquake induced forces in AWWA Standard D110-04 were written to conform to the 1994 Uniform Building Code (a 10% probability of exceedance in 50 years) and an alternative seismic design requirement of the 1997 Uniform Building Code. Requested AWWA D110-04 seismic design parameters are presented below.

Table 6: AWWA D110-04/1994, 1997 UBC Seismic Parameters

Parameter	Value
Seismic Zone (1994 & 1997 UBC Table 16-I)	3
Seismic Importance Factor, Z (1994 & 1997 UBC Table 16-I)	0.30
Importance Factor I (1994 & 1997 UBC Table 16-K)	1.25
Soil Profile Coefficient, S (1994 UBC Table 16-J)	1.2

2.02 Site-Specific Seismic Hazards Analysis

The computer program EZ-FRISK Version 7.62 Build 001 (Risk Engineering, 2011) was used in our analyses. Input parameters included: site coordinates (latitude = 38.453º, longitude = -121.4142º; soil site conditions (estimated shear wave velocity in the upper 30 meters, Vs_{30} = 246 m/sec, which corresponds to Site Class D); a fault search radius of 100 km; 10% probability of exceedance (P.E.) in 50 years and 100 years; 5% damping; and fault data based on a California Geological Survey/U.S. Geological Survey (CGS/USGS) fault model.

For horizontal accelerations, the NGA relationships by Boore-Atkinson (2008), Campbell-Bozorgnia (2008) and Chiou-Youngs (2008) were selected to analyze the mean maximum-rotated component motions corrected for near-source directivity effects (Huang and others, 2008). The empirical relationships developed by Agrahamson –Silva (1997) and Campbell-Bozoprgnia (2003) were selected to compute the mean vertical accelerations for the two seismic events. The computed horizontal and vertical response spectra ($S_{a,H}$ and $S_{a,V}$) in units of gravity (g) recommended for the project are presented in Table 7 and Figures 5 and 6.

Pseudo-relative velocity spectra, presented in Table 8 and Figures 7 and 8, were computed from the following formula: $S_V = Sa\ T/(2\pi) \times (32.2 \times 12)$ in units of inches per second.

Table 7: Recommended Site-Specific Probabilistic Acceleration Spectra

Period T (sec)	Horizontal Acceleration Spectra, $S_{a,H}$ (g)		Vertical Acceleration Spectra, S_{aV} (g)	
	Figure 5		Figure 6	
	10% P.E. in 50 yrs (475-yr ARP)	10% P.E. in 100 yrs (950-yr ARP)	10% P.E. in 50 yrs (475-yr ARP)	10% P.E. in 100 yrs (950-yr ARP)
0.00	0.232	0.288	0.111	0.143
0.05	0.264	0.330	0.171	0.229
0.10	0.375	0.468	0.227	0.304
0.20	0.511	0.628	0.239	0.303
0.25	0.518	0.634	0.217	0.271
0.30	0.521	0.637	0.202	0.248
0.40	0.491	0.596	0.192	0.235
0.50	0.475	0.577	0.161	0.202
0.75	0.403	0.494	0.127	0.155
1.00	0.337	0.415	0.107	0.129
1.50	0.242	0.303	0.080	0.099
2.00	0.181	0.299	0.061	0.076
3.00	0.117	0.148	0.039	0.050
4.00	0.088	0.111	0.029	0.036
5.00	0.072	0.093	0.024	0.030
7.50	0.043	0.058	0.011	0.013
10.00	0.027	0.038	0.005	0.007

Table 8: Recommended Site-Specific Probabilistic Velocity Spectra

Period T (sec)	Horizontal Velocity Spectra, $S_{v,H}$ (inches/sec)		Vertical Velocity Spectra, s_{vV} (inches/sec)	
	Figure 7		Figure 8	
	10% P.E. in 50 yrs (475-yr ARP)	10% P.E. in 100 yrs (950-yr ARP)	10% P.E. in 50 yrs (475-yr ARP)	10% P.E. in 100 yrs (950-yr ARP)
0.00	0.00	0.00	0.00	0.00
0.05	0.81	1.01	0.53	0.70
0.10	2.31	2.88	1.40	1.87
0.20	6.28	7.72	2.94	3.73
0.25	7.97	9.75	3.34	4.17
0.30	9.61	11.75	3.72	4.58
0.40	12.07	14.66	4.73	5.79
0.50	14.60	17.75	4.96	6.20
0.75	18.58	22.77	5.86	7.14
1.00	20.70	25.50	6.57	7.93
1.50	22.29	27.91	7.37	9.12
2.00	22.29	28.10	7.54	9.31
3.00	21.59	27.29	7.13	9.15
4.00	21.61	27.35	7.08	8.86
5.00	22.15	28.48	7.37	9.10
7.50	19.82	26.86	5.01	6.19
10.00	16.90	23.20	2.99	4.11

Figure 5: Site-Specific Probabilistic Horizontal Acceleration Spectra

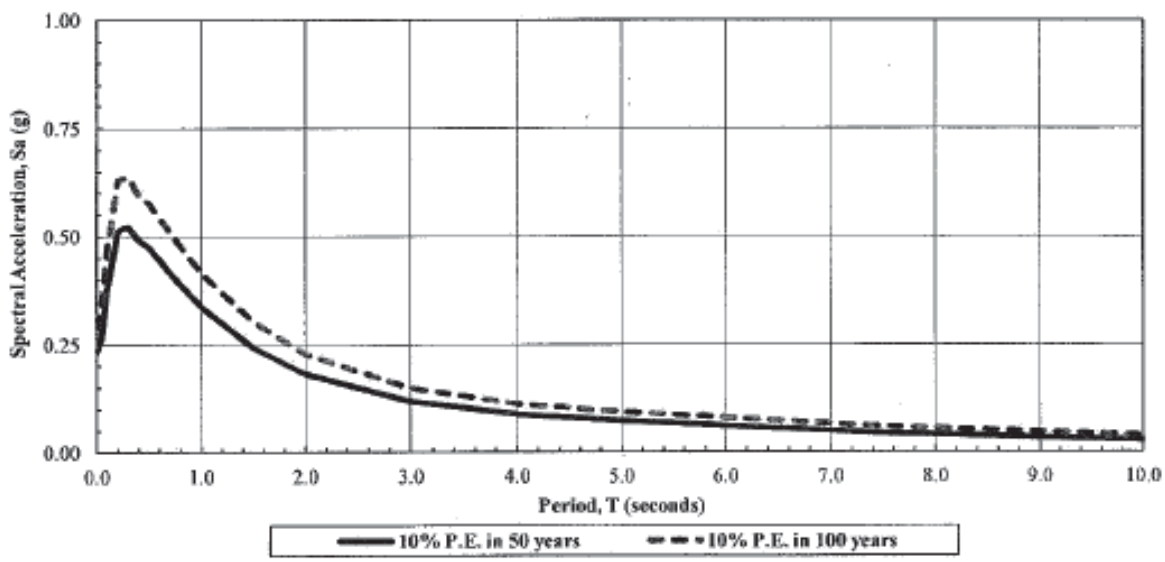


Figure 6: Site Specific Probabilistic Vertical Acceleration Spectra

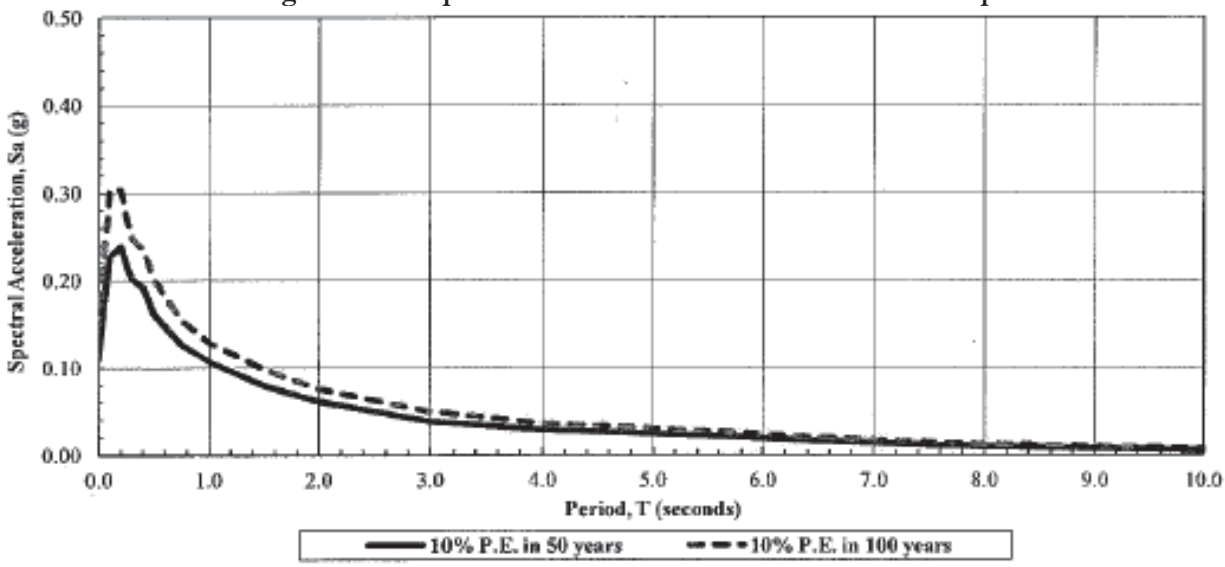


Figure 7: Site-Specific Probabilistic Horizontal Velocity Spectra

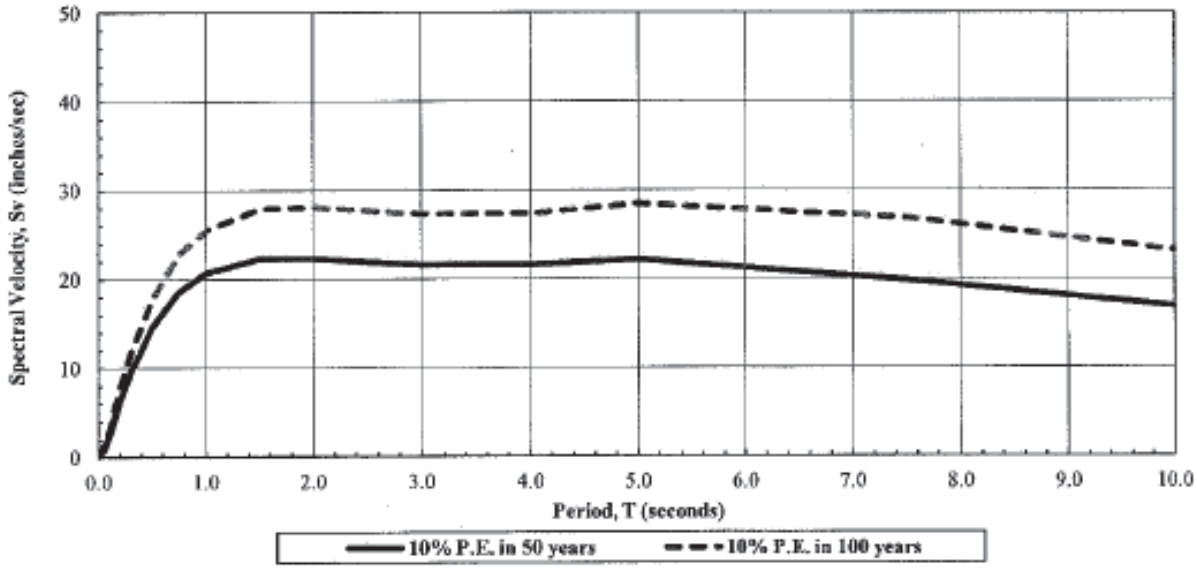
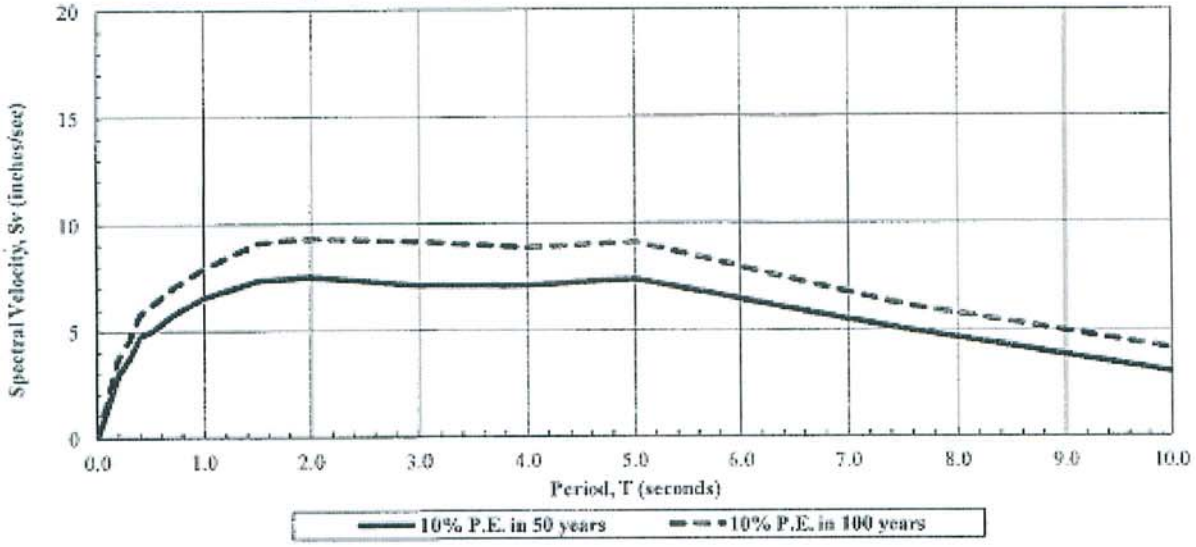


Figure 8: Site Specific Probabilistic Vertical Velocity Spectra



We trust that this report will serve your needs. If you have any questions or require further assistance, please do not hesitate to contact us.

Respectfully,

RMA Group

Gary Wallace, P.G., C.E.G.
Vice President

PROFESSIONAL GEOLOGIST
GARY W. WALLACE
No. 1255
CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

APPENDIX B

Table 4 – Summary of Water Quality Results

TABLE 4
SUMMARY OF WATER QUALITY RESULTS

City of Sacramento Shasta Park Production Well Sample Date: 5/12/2014	Notification Level	Primary MCL	Regulatory Action Level	Secondary MCL	Units	Result	Exceeds MCL
GENERAL MINERAL							
Bicarbonate Alkalinity (as CaCO3)					mg/l	160	☐
Calcium					mg/l	3.8	☐
Carbonate Alkalinity (as CaCO3)					mg/l	<4	☐
Chloride				250/500/600	mg/l	29.6	☐
Fluoride		2.0			mg/l	0.52	☐
Fluoride		2.0			mg/l	0.48	☐
Hardness (as CaCO3)					mg/l	14	☐
Hydroxide Alkalinity (as CaCO3)					mg/l	<4	☐
Magnesium					mg/l	1.1	☐
Nitrate (as NO3)		45			mg/l	<2	☐
Nitrate+Nitrite (sum as N)					ug/l	<400	☐
Nitrite (as N)		1			ug/l	<400	☐
Potassium					mg/l	3.7	☐
Sodium					mg/l	73	☐
Sulfate				250/500/600	mg/l	<0.5	☐
Total Alkalinity (as CaCO3)					mg/l	160	☐
GENERAL PHYSICAL							
Color				15	color units	1	☐
Odor - Threshold				3	TON	1	☐
pH					pH units	9.2	☐
pH					pH units	8.32	☐
Specific Conductance				900/1600/2200	umhos/cm	395	☐
Total Dissolved Solids				500/1000/1500	mg/l	280	☐
Turbidity				5	NTU	0.15	☐
INORGANICS							
Aluminum		1000		200	ug/l	<10	☐
Antimony		6			ug/l	<2	☐
Arsenic		10			ug/l	<1	☐
Barium		1000			ug/l	29	☐
Beryllium		4			ug/l	<0.5	☐
Cadmium		5			ug/l	<1	☐
Chromium		50			ug/l	<2	☐
Copper			1300	1000	ug/l	<2	☐
Cyanide		150			mg/l	<0.025	☐
Iron				300	mg/l	0.043	☐
Lead			15		ug/l	<1	☐

Note: " MCL" is the Maximum Contaminant Level established by the California Department of Public Health. Multiple values for MCL represent trigger levels or recommended/upper ranges.

TABLE 4
SUMMARY OF WATER QUALITY RESULTS (Continued)

City of Sacramento Shasta Park Production Well Sample Date: 5/12/2014	Notification Level	Primary MCL	Regulatory Action Level	Secondary MCL	Units	Result	Exceeds MCL
INORGANICS							
Manganese	500			50	ug/l	16	☐
Manganese (Filtered)	500			50	ug/l	18	☐
Mercury		2			mg/l	<0.0002	☐
Nickel		100			ug/l	<2	☐
Selenium		50			ug/l	<2	☐
Silver				100	ug/l	<1	☐
Thallium		2			ug/l	<1	☐
Vanadium	50				ug/l	<2	☐
Zinc				5000	ug/l	<20	☐
VOLATILE ORGANIC CHEMICALS							
Total Organic Carbon					mg/l	<1	☐
RADIONUCLIDES							
Uranium		20			pCi/L	<0.67	☐
GASSES							
Methane					mg/l	4.5	☐

Note: " MCL" is the Maximum Contaminant Level established by the California Department of Public Health. Multiple values for MCL represent trigger levels or recommended/upper ranges.

PROJECT #: Z14005400

PROJECT NAME: Shasta Park Water Facility

DEPARTMENT: Department of Utilities

DIVISION: Water

CITY OF SACRAMENTO

PROFESSIONAL SERVICES AGREEMENT FOR ARCHITECTS, LANDSCAPE ARCHITECTS, PROFESSIONAL ENGINEERS, AND PROFESSIONAL LAND SURVEYORS

THIS AGREEMENT is made at Sacramento, California, as of Aug 9, 2016, by and between the **CITY OF SACRAMENTO,** a municipal corporation ("CITY"), and

West Yost Associates
2020 Research Park Drive, Suite 100, Davis, CA 95618
Phone: (530) 756-5905 / Fax: (530) 756-5991

("CONTRACTOR"), who agree as follows:

1. **Services.** Subject to the terms and conditions set forth in this Agreement, CONTRACTOR shall provide to CITY the services described in Exhibit A. CONTRACTOR shall provide said services at the time, place, and in the manner specified in Exhibit A. CONTRACTOR shall not be compensated for services outside the scope of Exhibit A unless prior to the commencement of such services: (a) CONTRACTOR notifies CITY and CITY agrees that such services are outside the scope of Exhibit A; (b) CONTRACTOR estimates the additional compensation required for these additional services; and (c) CITY, after notice, approves in writing a Supplemental Agreement specifying the additional services and amount of compensation therefor. CITY shall have no obligations whatsoever under this Agreement and/or any Supplemental Agreement, unless and until this Agreement or any Supplemental Agreement is approved by the Sacramento City Manager or the City Manager's authorized designee, or by the Sacramento City Council, as required by the Sacramento City Code.

2. **Payment.** CITY shall pay CONTRACTOR for services rendered pursuant to this Agreement at the times and in the manner set forth in Exhibit B. The payments specified in Exhibit B shall be the only payments to be made to CONTRACTOR for the services rendered pursuant to this Agreement unless pursuant to Section 1, above, CITY approves additional compensation for additional services. CONTRACTOR shall submit all billings for said services to CITY in the manner specified in Exhibit B, or, if not specified in Exhibit B, according to the usual and customary procedures and practices that CONTRACTOR uses for billing clients similar to CITY.

3. **Facilities and Equipment.** Except as set forth in Exhibit C, CONTRACTOR shall, at its sole cost and expense, furnish all facilities and equipment that may be required for furnishing services pursuant to this Agreement. CITY shall furnish to CONTRACTOR only the facilities and equipment listed in Exhibit C according to any terms and conditions set forth in Exhibit C.

4. **General Provisions.** The General Provisions set forth in Exhibit D, that include indemnity and insurance requirements, are part of this Agreement. In the event of any conflict between the General Provisions and any terms or conditions of any document prepared or provided by CONTRACTOR and made a part of this Agreement, including without limitation any document relating to the scope of services or payment therefor, the General Provisions shall control over said terms or conditions.

5. **Non-Discrimination in Employee Benefits.** This Agreement is subject to the provisions of Sacramento City Code Chapter 3.54, Non-Discrimination in Employee Benefits by City Contractors. The requirements of Sacramento City Code Chapter 3.54 are summarized in Exhibit E. CONTRACTOR is required to sign the attached Declaration of Compliance (Equal Benefits Ordinance), to assure compliance with these requirements.

6. **Authority.** The person signing this Agreement for CONTRACTOR hereby represents and warrants that he/she is fully authorized to sign this Agreement on behalf of CONTRACTOR and to bind CONTRACTOR to the performance of its obligations hereunder.

7. **Exhibits.** All exhibits referred to herein are attached hereto and are by this reference incorporated as if set forth fully herein.

Executed as of the day and year first above stated.

CITY OF SACRAMENTO
A Municipal Corporation

By:_____

Print name:_____

Title:_____

For: John F. Shirey, City Manager

APPROVED AS TO FORM:

_____
City Attorney

ATTEST:

_____
City Clerk

Attachments

Exhibit A - Scope of Service
Exhibit B - Fee Schedule/Manner of Payment
Exhibit C - Facilities/Equipment Provided
Exhibit D - General Provisions
Exhibit E - Non-Discrimination in Employee Benefits

CONTRACTOR:

West Yost Associates, Inc
NAME OF FIRM

68-0370826
Federal I.D. No.

378-6256Z
State I.D. No.

87522
City of Sacramento Business Op. Tax Cert. No.

TYPE OF BUSINESS ENTITY *(check one)*:

_____ Individual/Sole Proprietor
_____ Partnership
__✓__ Corporation *(may require 2 signatures)*
_____ Limited Liability Company
_____ Other (*please specify:* _____)

Signature of Authorized Person

Jeffrey D Pelz, Vice President
Print Name and Title

Additional Signature *(if required)*

Dianne L. Lee, Secretary
Print Name and Title

DECLARATION OF COMPLIANCE
Equal Benefits Ordinance

Name of Contractor: West Yost Associates

Address: 2020 Research Park Drive, Suite 100, Davis, CA 95618

The above named Contractor ("Contractor") hereby declares and agrees as follows:

1. Contractor has read and understands the Requirements of the Non-Discrimination In Employee Benefits Code (the "Requirements") attached hereto as Exhibit E.

2. As a condition of receiving this Agreement, Contractor agrees to fully comply with the Requirements, as well as any additional requirements that may be specified in the City of Sacramento's Non-Discrimination In Employee Benefits Code codified at Chapter 3.54 of the Sacramento City Code (the "Ordinance").

3. Contractor understands, to the extent that such benefits are not preempted or prohibited by federal or state law, employee benefits covered by the Ordinance are any of the following:

   a. Bereavement Leave
   b. Disability, life, and other types of insurance
   c. Family medical leave
   d. Health benefits
   e. Membership or membership discounts
   f. Moving expenses
   g. Pension and retirement benefits
   h. Vacation
   i. Travel benefits
   j. Any other benefit offered to employees

   Contractor agrees that if Contractor offers any of the above-listed employee benefits, Contractor will offer those benefits, without discrimination between employees with spouses and employees with domestic partners, and without discrimination between the spouses and domestic partners of such employees.

4. Contractor understands that Contractor will not be considered to be discriminating in the provision or application of employee benefits under the following conditions or circumstances:

   a. If the actual cost of providing a benefit to a domestic partner or spouse exceeds the cost of providing the same benefit to a spouse or domestic partner of an employee, Contractor will not be required to provide the benefit, nor shall it be deemed discriminatory, if Contractor requires the employee to pay the monetary difference in order to provide the benefit to the domestic partner or to the spouse.

   b. If Contractor is unable to provide a certain benefit, despite taking reasonable measures to do so, if Contractor provides the employee with a cash equivalent Contractor will not be deemed to be discriminating in the application of that benefit.

c. If Contractor provides employee benefits neither to employee's spouses nor to employee's domestic partners.

d. If Contractor provides employee benefits to employees on a basis unrelated to marital or domestic partner status.

e. If Contractor submits written evidence of making reasonable efforts to end discrimination in employee benefits by implementing policies that will be enacted before the first effective date after the first open enrollment process following the date this Agreement is executed by the City of Sacramento ("City"). Contractor understands that any delay in the implementation of such policies may not exceed one (1) year from the date this Agreement is executed by the City, and applies only to those employee benefits for which an open enrollment process is applicable.

f. Until administrative steps can be taken to incorporate nondiscrimination in employee benefits. The time allotted for these administrative steps will apply only to those employee benefits for which administrative steps are necessary and may not exceed three (3) months from the date this Agreement is executed by the City.

g. Until the expiration of a current collective bargaining agreement(s) if employee benefits are governed by such collective bargaining agreement(s).

h. Contractor takes all reasonable measures to end discrimination in employee benefits by either requesting that the union(s) involved agree to reopen the agreement(s) in order for Contractor to take whatever steps are necessary to end discrimination in employee benefits or by ending discrimination in employee benefits without reopening the collective bargaining agreement(s).

i. In the event Contractor cannot end discrimination in employee benefits despite taking all reasonable measures to do so, Contractor provides a cash equivalent to eligible employees for whom employee benefits are not available. Unless otherwise authorized in writing by the City Manager, Contractor understands this cash equivalent must begin at the time the union(s) refuse to allow the collective bargaining agreement(s) to be reopened or not longer than three (3) months after the date this Agreement is executed by the City.

5. Contractor understands that failure to comply with the provisions of Section 4(a) through 4(i), above, will subject Contractor to possible suspension and/or termination of this Agreement for cause; repayment of any or all of the Agreement amount disbursed by the City; debarment for future agreements until all penalties and restitution have been paid in full and/or for up to two (2) years; and/or the imposition of a penalty, payable to the City, in the sum of $50.00 for each employee, for each calendar day during which the employee was discriminated against in violation of the provisions of the Ordinance.

6. Contractor understands and agrees to provide notice to each current employee and, within ten (10) days of hire, to each new employee, of their rights under the Ordinance. Contractor further agrees to maintain a copy of each such letter provided, in an appropriate file for inspection by

authorized representatives of the City. Contractor also agrees to prominently display a poster informing each employee of these rights.

7. Contractor understands that Contractor has the right to request a waiver of, or exemption from, the provisions of the Ordinance by submitting a written request to the City's Procurement Services Division prior to Agreement award, which request shall identify the provision(s) of the Ordinance authorizing such waiver or exemption and the factual basis for such waiver or exemption. The City shall determine in its sole discretion whether to approve any such request.

8. Contractor agrees to defend, indemnify and hold harmless, the City, its officers and employees, against any claims, actions, damages, costs (including reasonable attorney fees), or other liabilities of any kind arising from any violation of the Requirements or of the Ordinance by Contractor.

The undersigned declares under penalty of perjury under the laws of the State of California that the foregoing is true and correct, and that he or she is authorized to bind the Contractor to the provisions of this Declaration.

Signature of Authorized Representative

7/25/16
Date

Jeffrey D Pelz
Print Name

Vice President
Title

EXHIBIT A

PROFESSIONAL SERVICES AGREEMENT FOR DESIGN PROFESSIONALS

SCOPE OF SERVICES

1. Representatives.

The CITY Representative for this Agreement is:

Marc Lee / Associate Engineer
1395 35th Ave, Sacramento, CA 95822
Phone: (916) 808-7481 / Fax: (916) 808-1497 / mlee@cityofsacramento.org

All CONTRACTOR questions pertaining to this Agreement shall be referred to the CITY Representative or the Representative's designee.

The CONTRACTOR Representative for this Agreement is:

W. Franklin Helmick / Vice President
2020 Research Park Drive, Suite 100, Davis, CA 95618
Phone: (530) 792-3292 / Fax: (530) 756-5991 / fhelmick@westyost.com

All CITY questions pertaining to this Agreement shall be referred to the CONTRACTOR Representative. All correspondence to CONTRACTOR shall be addressed to the address set forth on page one of this Agreement. Unless otherwise provided in this Agreement, all correspondence to the CITY shall be addressed to the CITY Representative.

2. Insurance. Insurance requirements are specified in Exhibit D, Section 11.

3. Conflict of Interest Requirements.

A. **Generally.** Under the California Political Reform Act, Government Code §§ 81000 et seq., designated employees of the CITY are required to comply with the CITY's Conflict of Interest Code. The term "designated employees" is a term of art and includes individuals who are working for contractors who are providing services or performing work for the CITY and who are considered to be "consultants" under the Political Reform Act. The term "consultant" generally includes individuals who make, or participate in making, governmental decisions or who serve in a staff capacity. Individuals who perform work that is solely clerical, ministerial, manual or secretarial are not "consultants."

The CITY's Conflict of Interest Code requires designated employees, including individuals who qualify as "consultants", to file the following statements of economic interests:

(1) An "assuming office" statement of economic interests to be filed within 30 days after execution of the agreement between the City and the contractor;

(2) Annual statements of economic interests while the agreement remains in effect, to be filed not later than April 30 of each year; and

(3) A "leaving office" statement of economic interests to be filed within 30 days of completion of the contract.

The above statements of economic interests are public records subject to public disclosure under the California Public Records Act.

The CITY's Conflict of Interest Code also requires individuals who qualify as "consultants" under the Political Reform Act to comply with the conflict of interest provisions of the Political Reform Act, which generally prohibit individuals from making or participating in the making of decisions that will have a material financial effect on their economic interests.

B. **Conflict of Interest Statements.** The individual(s) who will provide services or perform work pursuant to this Agreement are "consultants" within the meaning of the Political Reform Act and the CITY's Conflict of Interest Code: __✓__ yes _____ no *[check one]*

If "yes" is checked above, CONTRACTOR shall cause the following to occur within 30 days after execution of this Agreement:

(1) Identify the individuals who will provide services or perform work under this Agreement as "consultants";

(2) Cause these individuals to file with the CITY Representative the "assuming office" statements of economic interests required by the CITY's Conflict of Interest Code.

Thereafter, throughout the term of the Agreement, CONTRACTOR shall cause these individuals to file with the CITY Representative annual statements of economic interests, and "leaving office" statements of economic interests, as required by the CITY's Conflict of Interest Code. The CITY may withhold all or a portion of any payment due under this Agreement until all required statements are filed.

4. Scope of Services.

The services provided shall be as set forth in Attachment 1 to Exhibit A, attached hereto and incorporated herein.

5. Time of Performance. The services described herein shall be provided during the period, or in accordance with the schedule, set forth in the scope of services.

Agreement sunset date is March 31, 2018

WEST YOST
ASSOCIATES
Consulting Engineers

July 5, 2016

SENT VIA: EMAIL

Mr. Brett Ewart
City of Sacramento Department of Utilities
1385 35th Avenue
Sacramento CA 95814

SUBJECT: Construction Management Scope of Services and Fee Estimate for the Shasta Park Water Facility

Dear Mr. Ewart:

As requested, we have prepared the following proposal for your review for Construction Management (CM) and inspection services for the City of Sacramento's (City) Shasta Park Water Facility project (Project). The scope of services is based on the scope of services provided on similar projects. Criteria utilized in preparing the Scope of Services and fee estimate, in conjunction with conversations with you, Mark Lee and the Request for Qualifications (RFQ) issued by the City on May 14, 2014, are as follows:

- Engineer's estimate for construction cost: $12.6 million
- Estimated construction contract duration: 15 months
- Construction management, general inspection, and part-time administrative services based on approximately 32, 16, and 20 hours/week, respectively
- A budget for soils and concrete testing, special inspection (masonry, welding, etc.) and electrical inspection – see attached subconsultant scope and fee estimates
- A construction management contingency budget of $53,345 (not to be used unless authorized by the City)
- Mileage to be billed separately from the Sacramento office to the job site or other locations required to perform our services at $0.56 per mile. A budget for this cost is included in the fee estimate

Our scope of services for this Project is divided into three phases, Pre-Construction, Construction, and Post Construction. Project management services related to each phase are included in each phase and a detailed description of these services is presented below.

PROJECT DESCRIPTION

The southwest portion of the City experiences low water system pressures during times of peak water usage and would benefit from the addition of ground-level water storage and additional pumping capacity. The Project includes the addition of a potable water well, groundwater

treatment systems, four-million-gallon potable water storage tank, a booster pump station, and ancillary facilities and will increase the City's ability to deliver a consistent and reliable water supply. The facility will be located east of Bruceville Road and immediately north of the newly constructed Shasta Park Library.

Task 1 – Preconstruction Services

Contract Plan & Specification Review

West Yost Associates (West Yost) CM group will work closely with the West Yost project design engineer, Jeff Wanlass, to review the contract plans, specifications, engineering files, permits, agreements, easements and environmental documents. A constructability review will be performed to identify any potential issues that may arise during the construction phase of the project. Items developed during the constructability review will be listed and discussed with the City Project Manager (PM) to determine what course of action may need to be taken to address the issue(s).

Project Schedule

West Yost will prepare a preliminary Project schedule that will include all preconstruction work items, construction utility relocations (if necessary), and notification timelines noted on all permits and contract documents. The Project schedule will be revised and updated, accordingly, upon receipt of the contractor's schedule.

Document Control Training

West Yost will use Procore Construction Project Management Software (a document control system) to manage the Project documentation. A self-paced online training program is available for all team members on the Project, which involves hands-on training to learn how to navigate the system; how to upload and download documents; how to issue correspondence, Requests for Information (RFI), submittals, memos, and transmittals; and how to respond to action items. Use of the online training is at no cost. If needed, West Yost can provide additional document control system training sessions with the Contractor, Owner, and Design Engineer at additional cost. The additional training sessions can be done online and via conference calls.

Preconstruction Conference

West Yost will prepare the agenda for and lead the Preconstruction Conference. Minutes will be prepared within three days of the conference. Open items will be included in the first weekly progress meeting and monitored weekly to conclusion. The agenda (at a minimum) will include the following:

- Award, execution, notice-to-proceed, contract time, and completion dates
- Project teams and organizations, lines of communication, and responsibilities
- Mobilization – field office layouts, parking, lay-down areas, site access, and security
- Project meetings
- Administrative requirements

- Safety
- Schedule constraints and sequencing
- Permits, encroachments, and other agreements—Owner furnished versus Contractor furnished
- Environmental requirements and constraints
- Project document control system overview – Procore Construction Project Management Software
- Shop drawing process and procedures, number of copies, turnaround times, etc.
- Material and equipment substitutions or "or equal" items, and long lead-time items
- Surveying and construction staking
- Materials testing
- Construction Critical Path Method (CPM) schedule requirements
- Measurement, payment, retention, withholds, cut-off dates, and pay request submittal requirements
- Labor compliance
- Pre-construction conditions
- Change order process including pricing and payment procedures
- Coordination with existing Plant operations
- Interconnect drawings
- Startup and testing
- Equipment storage and preventative maintenance
- Operations and Maintenance manuals
- As-built drawings and update requirements
- Preliminary notices and stop notices
- Substantial completion and final acceptance procedures

Task 1 – Preconstruction Services, Estimated Fee: $20,539

Task 2 – Observing Utility Company Relocations

Prior to construction activities, West Yost will evaluate existing utilities, if any, that may interfere with construction of the project. Where any existing utilities within proximity to the project site appear to conflict with the proposed facilities, the utility owner (public or private) will be notified and relocation of the utility in question will be coordinated. West Yost will observe relocation of the utilities and document the changes on the as-built drawings accordingly. It is assumed that any costs associated with relocation of an unforeseen utility, public or private, shall be borne by the City.

Task 2 – Observing Utility Company Relocations, Estimated Fee: $7,326

Task 3 – Construction Management Services During Construction

During construction activities, West Yost will be responsible for overseeing the project on behalf of the City and will perform tasks including project management, construction administration, scheduling, resident project observation/inspection, reviewing and approving all contractor submittals, and materials testing during construction. These tasks are described in greater detail below.

Project Coordination, Correspondence and Progress Meetings

West Yost will serve as the focal point for coordination among the contractors, surveyors, material testers, the design engineer, the City, other agencies, utility companies, and other parties involved with the construction of the Project. This includes maintaining close contact and copying the City on all correspondence. All Contractor correspondence will be received, processed and transmitted by West Yost to applicable parties as required to develop responses.

Weekly Project Meetings

Weekly Project Meetings are one of the most important project management tools to assure that all project objectives are being met by the responsible party(s) and to resolve issues before construction is adversely impacted. West Yost will conduct and facilitate each meeting and will have a standard agenda that is updated each week.

The weekly meetings are not just to coordinate efforts between the Contractor and the CM, but also between the CM and Design Engineer. Logs will be generated from the document control system and used to confirm receipt and "ball-in-court" responsibilities for each party. Correspondence, RFIs, and Submittals logs will be generated automatically by the document control system. All logs will be reviewed weekly to confirm everyone understands what is under review and whose responsibility it is for moving the issue or action item toward close-out or resolution.

The Standard Weekly Meeting Agenda will include the following items:

- Introductions
- Approval of previous meeting minutes

- Schedule Review and planning
- Safety & Security
- Quality Control/Quality Assurance
- Correspondence Log Review
- RFI Log Review
- Shop Drawing Submittal Log Review
- Change Orders
- Progress Payments
- Planned Absences
- New Business
- Next Scheduled Meeting

New items may be added to the Agenda occasionally as necessary to manage the construction effort. Minutes will be prepared and issued within three working days of the meeting.

Contract File Maintenance

Since all correspondence will be transmitted or posted in the document control system, all parties will have access to all project correspondence upon transmittal depending upon permissions established at the Project onset. If hard copies of correspondence are required, West Yost will maintain contract files at the job site trailer in a systematic and orderly manner

Schedule Management and Reports

West Yost will review the Contractor's construction schedules (initial 90 day and full construction schedule) and related reports to confirm that they are sufficiently detailed, complete, and that they accurately reflect the sequence of events and requirements to complete the Work. To better ensure that all scheduling requirements will be achieved by the Contractor, West Yost will confirm that the Contractor's proposed responsible scheduling person possesses the skills and experience required in the scheduling specifications. After this person is approved, West Yost will conduct a preconstruction scheduling meeting with the Contractor to discuss the Project scheduling requirements and discuss the Contractor's approach to meeting these requirements.

Work Progress Review/Schedule Analysis

West Yost will monitor the Contractor's progress during construction and compare the current activities observed in the field to the Contractor's most recent CPM Schedule Update. In addition, at each weekly meeting, West Yost will require the Contractor to present its four week look-ahead schedule. West Yost will compare mini-milestone activities such as completed excavation work, concrete pours, and important material deliveries, in the four week look-ahead schedule with the Contractor's most recent CPM Schedule Update. These reviews are essential to providing a better

understanding of actual as-built performance and a faster review of the Contractor's monthly updates.

Schedule revisions will be thoroughly reviewed for schedule logic and duration changes that might impact Project completion milestones. As necessary, additional scheduling meetings will be held to come to agreement on schedule activities, sequence, and duration.

West Yost will use the updated schedule to determine schedule slippage and in compliance with the contract requirements will request the Contractor provide recovery schedules to bring the Project back on schedule. If extra work is approved, West Yost will insert new activities and track the actual start and stop effort. This information will be used to facilitate discussions with the Contractor to determine if there is a need to accelerate any the Work or consider a time extension.

Monthly Progress Reports

West Yost will prepare and submit a monthly progress report to the City PM. The report will summarize the key issues, cost status, and schedule status. The report will include the various project logs (Submittals, RFIs, Potential Change Orders, etc.) and photographs of the active construction activities, as well as other key documents that will provide the City with a general overall status of the Project to date.

Payment Recommendations

Schedule of Value (SOV) Review

The Contractor will be required to submit its SOV that will be used to evaluate payment applications. West Yost will evaluate the SOV with two different methods. The first will use an empirical method using the accepted Baseline Schedule. The costs will be spread over time and used to determine a cumulative cost curve. The curve will be compared to a standard S-curve. If it resembles a standard curve, it will be a good indication that the costs are appropriately loaded across the duration of the Project. The second method will compare unit prices of similar work performed at the beginning of the Project to the same work performed later. If priced correctly, the unit rates should be about the same. The review will also confirm that enough detail is provided to allow accurate evaluation of progress payments throughout the duration of the Project.

Progress Payment Negotiation/Request Preparation

Each month, the Contractor will prepare a draft payment application based on the amount of work performed each month. The initial review will be performed with the inspector and finalized by the Contractor. The Contractor will formally transmit the application to West Yost for approval and processing by the City. West Yost will review the formal application and confirm that the values are correct and are consistent with contract requirements and amount of work completed during the pay period.

Submittals Management

All submittals will be transmitted or posted in the document control system. West Yost will review all submittals for completeness and accuracy and disseminate to all parties as appropriate. West Yost will update the submittal inventory to confirm that all of the required information was received. If information is needed to complete the requirement, the submittal will be returned to the Contractor un-reviewed and if appropriate will be discussed in the weekly progress meeting. For those submittals reviewed by the Design Engineer, the submittal will be returned to West Yost for the final review before being returned to the Contractor. It will be our goal to have each submittal reviewed only once. If information is lacking that prevents the submittal from being favorably reviewed (no exceptions taken or make corrections noted), West Yost will coordinate with the Contractor and Design Engineer to get the proper information posted. If the comments are minor enough to allow the progress to continue with follow-up action later, West Yost will work with the Design Engineer to revise the review status to a more favorable progress grade.

If a submittal is approved as "Make Corrections Noted", West Yost will keep a master punch list of these required corrections to assure all of the corrections are incorporated into the Work.

Requests for Information (RFI)

As with submittals, every RFI will be transmitted or posted in the document control system. Once an RFI is received, West Yost will perform the initial review. If the RFI can be answered by referring to contract requirements, or is related to Division 0 and 1 specification sections, West Yost will respond to the RFI without input from the Design Engineer. If the RFI is related to a design question, West Yost will forward it to the Design Engineer for their response. Once the Design Engineer responds, it will be forwarded back to West Yost for final review to confirm that the response is complete and adequately addresses the issue before being returned to the Contractor.

Change Orders and Claims

West Yost will take the lead in reviewing Potential Change Orders (PCO) and claims. All extra work requests and claims submitted by the Contractor will be filed in the document control system. West Yost will conduct an initial review, and determine if the request has merit or the work is part of the contract. If the request has merit, West Yost will review the cost and time requested and forward the request to the City with recommendations for approval. The process of evaluating entitlement will be reviewed with the City to determine if there is agreement to proceed with negotiating a change order, or denying the request.

It will be necessary to determine whether the PCO should be forward-priced or performed under a time and materials (T&M) basis. Our approach will be to try to negotiate a lump-sum agreement due to the many benefits of placing the risk to perform the additional work on the Contractor, as opposed to performing work on a T&M basis, which shifts the risk back to the City. To achieve a lump-sum agreement, it will be essential that West Yost prepare an independent estimate of the work.

Once all of the pertinent agreements have been achieved, a formal Change Order document will be prepared for submittal to the City for approval. Once approved, West Yost will notify the Contractor to include the change order work in their monthly progress payment request.

Construction Observation/Inspection Services

West Yost inspectors will be fully informed of the aspects of the project that are associated with their specific responsibilities through the Construction Manager and/or RE and will be required to become familiar with the plans and specifications. This effort requires studying the Contract Documents each day and reviewing the submittals that are related to the work currently being performed or planned in the coming weeks. Our inspector will attend the weekly progress meeting and the Contractor's weekly tailgate safety meetings to stay current on issues and to present issues directly that needs immediate attention to resolve.

The inspector will track work performed and work that is deficient and needs to be reworked by the Contractor. Tracking work performed will be done by annotating their own personal set of plans and specifications or in some cases on spreadsheets such as steel reinforcement bar schedules or cable schedules.

Daily Reports

The inspector will take notes during the course of the day to document the work performed. Information will also include manpower and equipment used, weather conditions and any other items that affect the construction activities. At the conclusion of each day, the inspector will enter the data and information collected in the Daily Reports Log in the document control system. The inspector will also note conversations of importance that were conducted with the Contractor, Plant Operators, or Design Engineer and include that information in their daily report. Weather conditions such as rain, wind, humidity (fog), temperature will also be documented, and any other adverse conditions that could result in a non-compensable time extension. This information will be summarized at the end of each week by the inspector in a weekly report to the City that summarizes the work performed and what is planned for the coming week.

Photographic Documentation

The inspector will complement the daily report with digital photos of the work. Included in each daily report will be photos that show the extent of the work performed that day, photos that might be useful to the City in the future (such as pipes and conduits before backfill), or photos used by the CM in resolving a time-related dispute.

As-Built Drawings

It is essential that a good set of as-builts be turned-over to the City upon completion of the Project. During the course of the Project, West Yost will monitor the Contractor's efforts in maintaining a record set of as-built drawings and specifications. Notations such as RFI responses, clarifications, and Change Orders will be checked. If there are important components that may be difficult to locate once buried or cast in concrete, rough measurements will be used to approximate the location. The review will occur each month and progress payments may be withheld until the record drawings are updated to an acceptable level.

Electrical/Process & Instrumentation Inspection

West Yost included J. Calton Engineering, an electrical consultant that specializes in instrumentation and SCADA control systems, on our team. John Calton, PE will be responsible for confirming that the electrical work performed is in compliance with the contract requirements, codes, and industry standards. He will be required to prepare a written daily report when on-site to inspect the work or attend special meetings and file to the document control system by mid-morning of the following day.

J. Calton Engineering will transmit to West Yost, at the conclusion of each day when they were on-site, or if they are requested to perform factory inspections, a written daily report that summarizes what was performed by the contractor, tests performed with results, other items of importance, and acceptability of the work performed. This report will be scanned and uploaded into the document control system in the Daily Reports Log.

Quality Assurance Testing

West Yost included Blackburn, a geotechnical and materials testing/inspection consultant, on our team. Blackburn will be responsible for quality control on the project and will have procedures for providing the level of quality specified by the Contract Documents and industry standards.

Tests anticipated to be performed are:

- ACI concrete quality control during pours, and concrete compressive strength tests
- In-situ backfill compaction testing, moisture content, moisture-density relationships, and sieve analysis
- Moisture-density and relative density tests on trench fill
- Masonry inspection and grout/mortar compressive strength testing
- Epoxy anchor pull testing
- Laboratory Testing (Soil, Aggregate Base, PCC Aggregate, Crushed Rock Bedding, Sand Bedding, Hot Mix Asphalt (HMA) Aggregate, and HMA.

Data will be collected and reported by Blackburn once the information on the specific tests becomes available. These results will be reviewed to confirm that the information is correct and in compliance with the contract requirements. If issues are found, West Yost will work with the Contractor and Blackburn to revisit and determine a corrective action plan. All tests will be scanned and attached to the daily inspector report for the actual day the testing occurred and uploaded into the document control system.

The results will be reviewed at the Weekly Progress Coordination Meeting and if there are areas of concern they will be tracked until resolved.

Task 3 – Construction Management Services During Construction, Estimated Fee: $810,199

Task 4 – Construction Staking

Per discussions with City staff in August of 2015, this Task has been removed from our proposal.

Task 4 – Construction Staking, Estimated Fee: $0.00

Task 5 – Post Construction Services

Final Inspection, Punchlist, and Notice of Completion

West Yost will schedule and conduct the substantial completion inspection, issue punch lists, and review compliance. West Yost will coordinate with the City and schedule, conduct, and complete final inspection of the Project. We will also assist in negotiation of unsettled claims or disputes. When all final punchlist items have been completed or resolved, West Yost will recommend final acceptance to the City. We will obtain bonds, guarantees, warranties, operation and maintenance manuals, spare parts, and record drawings from the Contractor and deliver them to the City.

Using the redlined set of working record drawings received from the Contractor, in addition to the redline working record maintained by West Yost, we will review the formal record drawings for submittal to the Design Engineer.

West Yost will prepare a final Project report that will include a total Project cost analysis, project progress analysis of planned and actual milestones, and a summary of contract start-up, close-out, and acceptance including final summary of change orders and resolution of claims or disputed work.

At Project close-out, West Yost will submit the following close-out items to the City's representative:

- Copies of records and plans maintained by West Yost during construction
- Copies of approved shop drawings, submittals, and manufacturer's literature maintained by West Yost during the construction Project
- One complete set of annotated Project progress photographs, organized chronologically and logged into a database
- Copies of field inspection reports and correspondence

Task 5 – Post Construction Services, Estimated Fee: $21,621

Task 6 – Contingency Budget

Per discussions with City staff, West Yost included a contingency budget for additional CM services due to extenuating circumstances that would require the Contractor to work overtime hours to meet schedule milestones.

Task 6 – Contingency Budget, Estimated Fee: $53,345

Task 7 – Overhead Direct Costs

The overhead direct costs task includes a budget for vehicle mileage/usage. This budget consists of mileage to be billed separately from the Sacramento office to the job site or other locations required to perform our services at $0.56 per mile.

Task 7 – ODCs, Estimated Fee: $20,480

SCHEDULE AND BUDGET

The schedule for completing the services is based on the Engineer's estimate of 15 months and the budget for the scope of services described above is $933,510.00. West Yost will notify the City in writing when 75 percent of the budget is reached. Should the contract time be extended beyond 15 months, due to unforeseen conditions and/or overtime hours worked by the Contractor, West Yost will meet with the City to negotiate a contract amendment to also extend the CM services.

STAFFING

Our proposal is based on offering the services of Jack Harbour as the Construction Manager, Tom Lake as the Resident Inspector, and Kristen Burris as the Technical Specialist/Administrative Assistant. In the event that backup and/or additional CM, inspection and/or administrative services become necessary, West Yost proposes J.P. Davis as the alternate CM/Resident Inspector and Max Colorado as the alternate Technical Specialist/Administrative Assistant. Resumes for J.P. Davis and Max Colorado are attached. Any additional quality assurance services not identified herein can be provided at the request of the City for an additional fee.

If you have any questions regarding this proposal, please contact me at your convenience.

Sincerely,

WEST YOST ASSOCIATES

W. Franklin Helmick
Principal-in-Charge
RCE #34785

WFH:lh

Attachments

West Sacramento Office:
2491 Boatman Ave. ▪ West Sacramento, CA 95691
(916) 375-8706 ▪ Fax (916) 375-8709

blackburn consulting

Main Auburn Office: (530) 887-1494
Fresno Office: (559) 438-8411
Modesto Office: (209) 522-6273

Geotechnical ▪ Geo-Environmental ▪ Construction Services ▪ Forensics

File No. 2753.X
October 10, 2014

Mr. Jean Pierre Davis, P.E.
Construction Manager II
West Yost
2020 Research Park Dr., Suite 100
Davis, CA 95618

Subject: **SCOPE OF SERVICES FOR MATERIALS TESTING AND SPECIAL INSPECTION**
Shasta Park Water Facility, Sacramento, CA

Dear Jean Pierre,

Blackburn Consulting (BCI) used the 90% Improvement Plans and Specifications for the Shasta Park Water Facility project along with the 2010 State of California Standard Specifications to provide this Scope of services to perform Materials Testing and Special Inspection for the project.

We present our Scope of Services and Fee Estimate (attached) below.

SCOPE OF SERVICES

Based on our review of the above documents, BCI provides the following scope of services to perform materials testing and special inspection for the project:

- Attend preconstruction and construction meetings as needed.
- Perform observation and compaction testing of fill for structures, pads, general fill, yard piping and underground utilities. Perform compaction testing for surface improvements including subgrade and aggregate base.
- BCI will obtain samples of the concrete during placement; perform slump, air content, and temperature tests, cast cylinders and perform laboratory compressive strength testing for structural concrete at the Booster Pump Station, Drainage/Dewatering Pump Station, Aeration Tank, Control building, 3-Cell Filter, Backwash Tank, 4MG Concrete Tank, miscellaneous concrete appurtenances, and Transformer Pad.
- Perform Special Inspection of post-installed anchors.
- Perform materials sampling and laboratory acceptance testing as required for aggregate base, structure backfill, and import borrow.

- Provide certified AWS-CWI welding inspection as needed.
- Provide full time ICC masonry inspection including:
    - Block placement, layout, and installation
    - Reinforcing steel layout and installation
    - Grout and mortar sampling and testing
- Perform hot mix asphalt (HMA) sampling and laboratory testing in accordance with Section 39 of the 2010 Caltrans Standard Specifications and Caltrans Test Method 375.

Testing will be performed on a time and expense basis according to the project plans and specifications and State of California Standard Specifications. BCI will prepare and submit Daily Field Reports and Laboratory Test Reports to West Yost and governing agencies.

FEE ESTIMATE

We estimate a fee of $99,761 to provide the scope of services described above. An itemization of our estimate is attached. Our estimate is based on limited information, and depends greatly on factors unknown at this time such as differing site conditions, changes to the Plans and Specifications, the contractor' schedule, and re-testing. Our experience shows that our fee could be up to 15% more or less than our estimate. We will notify you in a timely manner if we anticipate exceeding our estimate.

Thank you for allowing Blackburn Consulting the opportunity to provide our services to West Yost. We look forward to working with you. Please let us know if you have any questions or need more information.

WEST YOST ASSOCIATES

J.P. Davis, PE, CCM, QSP

JP has over 17 years of experience in civil engineering, construction management and inspection for commercial, industrial and capital improvement projects focusing on water/wastewater infrastructure projects including pre-treatment and filtration structures, pump stations, reservoirs, large diameter underground piping, and hydro-pneumatic surge tanks. His experience as a construction manager, resident engineer and inspector includes constructability review, management of construction documentation, management of staff and sub consultants, contract and change order negotiations, budget and schedule review tracking and analysis, schedule of values and progress payment review, chairing of progress meetings and lead inspection and project tracking including written and photographic documentation of daily construction activities.

JP also has a strong background in geotechnical engineering and materials testing and inspection. His experience in these fields includes borehole soil logging and sampling, performance and oversight of laboratory soils and construction materials testing, preparation of geotechnical investigation/compaction reports, grading and AC paving observation/inspection, field in-situ compaction testing, special inspection, and forensic destructive/non-destructive data compilation and analysis for geotechnical expert testimony in residential construction defect litigation. In addition to being a Certified Construction Manager, JP is a California-licensed Professional Engineer and a Qualified SWPPP Practitioner (QSP).

EXPERIENCE

Phase 2 Biological Nitrogen Removal/Tertiary Treatment Project, City of Modesto, CA: Assistant Construction Manager/Resident Engineer for the City of Modesto's $100 million construction of the Phase 2 Biological Nitrogen Removal/Tertiary Treatment improvements. The project includes a complete constructability review of contract documents. The Phase 2 construction management oversees the construction of a new advanced secondary treatment and tertiary treatment facilities within the footprint of the existing secondary plant. This 12.6 mgd advanced treatment system utilizes MBR technology, with appurtenant disinfection and screening facilities, along with new building and effluent pipelines/pump stations. Critical equipment, including MBR and UV equipment, was prepurchased and "assigned" to the successful bidder on this project.

Oak Park Combined Sewer System Regional Storage Facility, City of Sacramento, CA: Resident Engineer and Lead Inspector during construction of this $10 million project including an underground combined sewer (CS) storage facility consisting of 6,200 linear feet of 120-inch inside diameter (ID) reinforced concrete pipe (RCP) connected to a cast-in-place inlet/outlet structure, and an associated pump station. This facility ties-in to the existing CS system via a 72-inch ID RCP and diversion structure. The large structure, with a capacity of up to 4 million gallons, provides storage during heavy rainfall periods. In addition to the underground storage facility, a community soccer

Professional Registrations

- Professional Civil Engineer, California No. C66826
- Certified Construction Manager, Construction Management Certification Institute, ID No. 4505
- Qualified SWPPP Practitioner, Certificate No. 25223

Education

- BS, Civil Engineering, University of California, Irvine

Professional Affiliations

- American Public Works Association
- Construction Management Association of America
- American Society of Civil Engineers

Special Certifications

- US Army Corps of Engineers Construction Quality Management for Contractors #784
- OSHA Permit-Required Confined Space Entry, Certificate No. 39454
- CAL OSHA 10 Construction Safety, 10-hour Training, September 2014

field, among other park amenities, was constructed for public use. The project was built in an existing park site located in the center of a residential community, bringing public inconvenience to the forefront of the project challenges. JP performed extensive public outreach including hand delivering monthly newsletters to impacted residents in the area and holding monthly block meetings to address concerns before they became issues. JP also worked closely with the Contractor and residents to create a material delivery/excavation spoils off-haul route and traffic control plan during open-cut pipe installation down the residential street that prevented resident ingress/egress disruption. This proactive approach minimized public inconvenience, ultimately leading to the safe and successful completion of the project. JP was instrumental in coordination with PG&E and SMUD for relocation of an existing gas line and installation of a new transformer to minimize impact on the CPM schedule. JP also coordinated between the City departments including Utilities, Parks and Recreation, and General Services to ensure the Contractor met all various department requirements for connection to existing facility components. The project was completed within the allotted contract time and budget, with a change order total less than 2.5 percent.

Construction Management & Inspection Services for the 2015/2016 Sewer Service Line Replacement Project, City of Folsom, CA: Construction Manager. West Yost is providing construction management and part-time inspection services for the City of Folsom's (City) $0.5 million 2015-16 Sewer Service Line Replacement Project, which will address ongoing maintenance problems and consists of repairing/replacing existing damaged and/or deteriorated sewer mains and laterals identified throughout the City. This project will reduce inflow and exfiltration, minimize annual maintenance costs, and minimize the risk of sewer overflows. The project includes conducting TV inspection of sewer lines to determine if rehabilitation and/or replacement of existing sewer laterals will be required. Sewer laterals from the main line up to the sewer cleanouts and segments of sewer main found with significant damage and/or deterioration causing leakage and/or creating a potential blockage will be removed and replaced.

Water Treatment Plant Drinking Water Improvement/ Disinfection Facilities Upgrade Project – Phase 4A, City of Folsom, CA: Resident Engineer and Inspector during construction of this $10 million project including a 1.2 million gallon DYK pre-stressed reinforced concrete chlorine contact tank (CCT) with interior baffle walls, a cast-in-place CCT vault housing the inlet/outlet valves, and installation of large diameter 48-inch and 66-inch diameter finished water (FW) cement lined and coated welded steel piping between the new filter structure, CCT, and existing FW reservoirs. Mass excavation, backfill and compaction operations for construction of the new filter structure and new pretreatment facilities was performed, along with installation of underground process piping, site drainage piping, chemical piping, underground electrical, instrumentation and controls, and SCADA system upgrades. Project challenges included diligent oversight of QA/QC operations during reinforcement and concrete placement at the CCT as well as disinfection of the facility before placement into service. Concrete for the CCT was placed in the summer so concrete temperature, batch shelf-life, truck revolutions, slump, air entrainment, etc. were heavily scrutinized prior to placement to ensure the water retaining structure was built in accordance with the specifications. JP also spearheaded the disinfection operations of the tank and FW piping, which were performed in accordance with AWWA standards with several chlorine injection locations, and multiple bac-T sample points were designated to ensure thorough disinfection of the system.

Water Treatment Plant Facilities Improvement Project – Phase 4B, City of Folsom, CA: Resident Engineer and Inspector during construction of this $14 million project including construction of six new dual media gravity filters and modifications to the four existing gravity filters, new weir structure with level controllers and modifications to the existing weir structure, construction of two Kruger pretreatment facilities (Actiflo), installation of submersible and vertical turbine pumps and placement of large diameter 48-inch to 66-inch underground piping. Also included in the project was the installation of a Sodium Hypochlorite generator, positive displacement blower and piping, construction of a new effluent water meter vault, site drainage, site access road grading and asphalt paving, chemical and process piping, installation of underground electrical, instrumentation and controls, and new SCADA system. Key project challenges included integration of the new facilities into the existing SCADA system, and commissioning of the new filters and Actiflo pretreatment structure to meet water quality requirements, all while maintaining daily water treatment operations. JP worked closely with the plant operations staff and the Contractor to coordinate system outage requests to tie-in the new facilities to the existing system and provided oversight during trial and error batching of polymer at the Actiflo to achieve required turbidity levels.

Natoma Standpipe Relocation Project, US Bureau of Reclamation (USBR)/City of Folsom, CA: Resident Engineer and Lead Inspector during construction of this $2.1 million project involving relocation of the existing City of Folsom main raw water (RW) feed system standpipe to allow for concurrent construction of the new

bridge across the American River by a separate contractor. The project consisted of demo of existing steel standpipe and construction of a reinforced concrete standpipe, rerouting of a 48-inch/60-inch raw water main line from the Folsom lake dam that feeds the City of Folsom Water Treatment Plant and Folsom State Prison, site and access road grading and asphalt paving, installation of underground electrical, instrumentation and controls, and SCADA system upgrade. Key project challenges included coordination with the USBR, City of Folsom, Folsom State Prison, the Contractor and the bridge contractor to facilitate shutdowns for tie-in of the RW pipe and standpipe system. JP worked with the Contractor to formulate a stringent system outage request procedure to address water supply back-up options for the prison in the event the tie-in exceeded the planned shut-down period and coordinated joint meetings with the project stakeholders to ensure tie-in of the new RW lines into the existing system was a success. Also due to the proximity of the project site to the American River and Folsom Lake, the local regional water quality control board (RWQCB) frequented the site. JP worked closely with the Contractor to reinforce their SWPPP BMPs regularly to contain any sediment site runoff and avoid costly fines.

Folsom WTP – Zone 2 & 3 Cimarron Pump Stations Improvement Project, City of Folsom, CA: Resident Engineer and Inspector during construction of this $3.4 million project including a potable water pump station, installation of 20-inch to 48-inch underground water line and pump transmission piping, demo of four (4) existing vertical pumps and installation of eight submersible and vertical turbine pumps. Also included in the project were modifications to two (2) existing 1 million gallon steel FW reservoir tanks including standpipe alterations and installation of interior water circulation piping. In addition, the project involved installation of a hydro-pneumatic surge tank system, a new stand-by-generator, installation of underground electrical, instrumentation and controls, and SCADA system upgrades. Key project challenges included coordination with the plant operations staff and Contractor for tie-in of the new piping and pumps into the existing system, and commissioning of the new standby generator and hydro-pneumatic surge tank. JP worked with the Contractor to utilize a system outage request procedure for the City to review and approve before tie-in of the new pumps and piping, preventing any unforeseen issues from occurring that could lead to water supply issues. JP also coordinated with Sacramento County Air Quality Management District during start-up procedures to certify the standby generator met regulation requirements.

Folsom WTP – Zone 3 Foothills Pump Station Improvement Project, City of Folsom, CA: Resident Engineer and Inspector during construction of this $1.6 million project involving installation of five (5) submersible and vertical turbine pumps and large diameter 30-inch to 48-inch transmission piping, stand-by-generator, hydro-pneumatic surge tank system, and installation of underground electrical, instrumentation and controls, and SCADA system upgrades. Key project challenges included commissioning of the new standby generator and testing of the hydro-pneumatic surge tank. JP coordinated with Sacramento County Air Quality Management District during start-up procedures to certify the standby generator met regulation requirements and worked closely with the plant operations staff and Contractor to simulate a surge in the system to verify functionality of the hydro-pneumatic surge tank.

North Auburn Highway 49 Transmission Pipeline Project, Nevada Irrigation District, Auburn, CA: Resident Engineer and Lead Inspector during construction of this $1 million project including a new water supply transmission main along the east side State Route 49 (SR49) corridor within the Caltrans right-of-way between Locksley Lane and Quartz Drive in Auburn, CA. The project included 140 ft jack and boring operations across SR49 on Quartz Dr. to a tie-in point on the west side of SR49, as well as 325 ft jack and boring operations across Rock Creek to a tie-in point on Locksley Lane, and replacement of associated butterfly valves in the Placer Counter right-of-way. Key issues on this project included diligent traffic control and settlement monitoring during jack and bore operations, and SWPPP reinforcement due to proximity of the construction activities to the existing creek. JP worked closely with the Contractor and Caltrans Permit Encroachment/SWPPP Officers to make sure the Contractor was in compliance to avoid work stoppages due to creek contamination during pipeline installation or unsafe conditions caused by poor execution of the approved traffic control plan.

Wastewater Treatment Plant – Phase 3 Improvements, Tuolumne City Sanitary District, CA: Resident Engineer and Lead Inspector during construction of this $2.6 million project including an Influent Alkalinity Adjustment facility, Effluent Disinfection System facility, Multi-Use Building, sludge storage lagoon improvements, SCADA program and dissolved oxygen (DO) controls improvements, various underground pipeline installations/tie-ins, site grading and paving. The above improvements were constructed while maintaining an operational treatment facility, requiring daily coordination with plant operations staff and Contractor. The project was completed on time and change orders were less than 2 percent of the total project cost.

S Street Sewer Brick Main Replacement, 7th St. to 14th St., City of Sacramento, CA: Assistant Resident Engineer and Lead Inspector during construction of this

$2.8 million project including replacement and upsizing of an existing 55-in. hand-made brick combined sewer (CS) line pipe and upgrading of drain inlets and associated lead piping. The brick CS line was replaced with 3,000 linear feet of pipe ranging from 72-inch to 84-inch diameter, tied-in to the existing CS service system with manholes constructed at pipe intersection locations. Also included in the project was re-grading and asphalt pavement replacement on S St. between 7th St. and 14th St. Key issues included diversion of the existing live CS line while installing the new larger pipeline. JP worked with the Contractor and the City to track and analyze the flow of the combined sewage when temporary plugs were placed at designated upstream manholes to allow for more efficient pipe placement, resulting in the project being completed well ahead of schedule and under budget. Business and homeowner driveway access was also critical since the pipeline was installed down a major downtown street. JP performed proactive coordination with the Contractor and public outreach with the businesses and residents to make sure driveway access was available at all times, minimizing loss of business created by customer inaccessibility and public inconvenience.

5th Street Sewer Upsizing, P St. to U St., City of Sacramento, CA: Assistant Resident Engineer and Lead Inspector during construction of this $2 million project involving replacement of 2,700 linear feet of an existing 60-in. combined sewer (CS) line with 72-inch diameter glass reinforced polyester pipe along 5th St. between P St. and U St., and tied-in to the existing CS service system with manholes constructed at pipe intersection locations. Also included in the project was the construction of an inverted siphon that tied-in to an existing storm drain system for scheduled maintenance purposes, upsizing of the existing drain inlet leads, re-grading, and asphalt pavement replacement on 5th St. between P St. and U St. Key project challenges included unforeseen soils conditions during pipe installation operations resulting in sloughing of the 16-foot deep trench walls as excavation progressed. JP maintained thorough documentation during extra work efforts to backfill the trenches, including manpower, equipment and backfill materials, which minimized the City's exposure to inflated change orders.

Water Meter Installation Project, City of Folsom, CA: Resident Engineer and Inspector during this $4.4 million project including installation of 5,400 residential potable water meters, associated piping, and meter vaults throughout the City of Folsom in accordance with current AWWA standards. Key project challenges included installation monitoring, budget and schedule tracking and cost allocation for each meter installed due to varying installation conditions. Another critical element to the success of the project was the extensive public relations/outreach JP performed before, during, and after construction due to the invasiveness of the project on private property (i.e. temporary disruption of water service, installation of meters within existing landscaping, adjacent to trees, in custom stamped concrete driveways, etc.). Public outreach included town hall meetings before placement at each of the 12 installation zones throughout the City, block meetings and meeting with residents on a case-by-case basis to address homeowner questions or concerns. JP's responsiveness to the residents when an issue arose resulted in quick repair turnaround time and good customer service calls from the homeowners to the City.

Water Meter Installation Project – Phase 2, City of Woodland, CA: Field Engineer and Inspector during construction of this project involving installation of over 10,000 potable water meters, associated piping, and meter vaults throughout the City of Woodland in accordance with current AWWA standards. Major project duties included final inspection of water meter installation, and collection of water meter unit information utilizing a Trimble GPS device, Bluetooth enabled barcode scanner, and WiFi hot spot device to transfer meter data directly to the project database.

WEST YOST ASSOCIATES

Max Colorado

Max Colorado has over 12 years of administrative experience including construction management document control. She brings excellent organizational and computer skills to construction and office projects. Her experience includes full construction management administration including document tracking and routing of submittals, requests for information (RFIs), assembling change orders, progress payments, correspondence, meeting minutes, and reports using Primavera Contract Management software and Access databases. Projects include wastewater treatment plants, pump stations, pipelines, storage tanks, and levees. Max also provides assistance with SRF loan disbursement requests and is the coordinator for West Yost project specifications and the West Yost Guide Specification Program.

EXPERIENCE

DOCUMENT CONTROL

In addition to providing administrative services for CM projects, Max routinely assists West Yost design engineers on projects requiring services during construction. For these projects, she provides tracking and logging of RFIs and Submittals, Progress Payment verification, assembling change orders, and overall document control to assure timely responses and accountability from internal staff and subconsultants. These projects have included:

- Large Diameter Water Mains in Northeast Fresno, Segments 1 and 2, City of Fresno, CA
- Large Diameter Water Mains in Southwest Fresno, City of Fresno, CA
- Howard Heights Water Main Replacement Project, City of Fresno, CA
- Ophir Road Pipelines, Placer County Water Agency, Auburn, CA
- Auburn Tunnel Plug Removal, Placer County Water Agency, Auburn, CA
- Stoneridge Joint Water Storage Facility, City of Roseville, CA
- Wastewater Storage and Disposal Expansion, Lake Berryessa Resort Improvement District, Napa, CA

FUNDING

Max is serving as administrative assistant for SRF loan disbursement assignments, and in that role is responsible for working with the project manager on the submission of disbursement requests of SRF funding for $320,000,000 from the State Water Board's Drinking Water SRF Program and Clean Water SRF Programs.

Max is currently working on the submission of disbursement requests for SRF funding for the following projects:

- Clean Water State Revolving Fund (SRF), City of Davis: $81,000,000 loan for improvements to the City's wastewater treatment plant.

CERTIFICATIONS/TRAINING

- First Aid and CPR/AED, American Heart Association, Certified, May 2013
- 10-Hour OSHA Certification

PROFESSIONAL ASSOCIATIONS

- Former Secretary, American Construction Inspection Association (ACIA), Folsom Chapter.

- SRF Funding, City of Woodland, California: $143,000,000 Safe Drinking Water SRF loan for the City of Woodland's portion of the Davis Woodland Water Supply Project (DWWSP) and their local City facilities.
- SRF Funding, Woodland-Davis Clean Water Agency, Davis, California: $95,500,000 Clean Water SRF loan for the Davis Woodland Water Supply Project for the City of Davis portion of the project.

SPECIFICATION COORDINATION

Max is the specification coordinator for West Yost, providing oversight for formatting, references, and overall compliance with West Yost and Construction Specifications Institute (CSI) standards for project specifications. Max provided project specification coordination for the following design projects:

Adkins Consulting

- Tulelake Wastewater Treatment Plant

Brookfield Bay Area Builders

- (City of Rohnert Park) Tank 8 Schedule A&B

California American Water Company

- Backyard Main Replacement, Antelope System, Phase I
- Backyard Main Replacement, Antelope System, Phase II
- 2015-17 Water Replacement Improvements, Iselton System
- 2015-17 Water Main Improvements, Lincoln Oaks, Phase I
- 2015-17 Water Main Improvements, Lincoln Oaks, Phase II

Castro Valley Sanitary District

- Rehabilitation and Replacement Program
- Pump Stations 3 and 4 Upgrades

Chaudhary & Associates

- Coral Sea Pump Station
- City of Burlingame
- Washington Well

City of Fairfield

- Sludge Lagoon Decant Structure Improvements (Lagoon 1)
- Sludge Lagoon Decant Structure Improvements (Lagoons 2 & 3)

City of Folsom

- Basin 6 Repairs
- Oak Avenue Parkway Pump Station Upgrades
- US Highway 50 Water Crossing Pipeline (FPA)

City of Galt

- Wastewater Treatment Plant Upgrade Final Design
- Water Treatment Plant Arsenic Sludge Removal

City of Hayward

- WPCF Digester Improvements

City of Jackson

- WWTP Improvements

City of Lodi

- White Slough WPCF - Digester 1 and 2 Repairs

City of Modesto

- Downstream Water System Improvements-Tier 1 (North Tank 11 & Pump Station)

City of Napa

- Dwyer Road Pump Station

City of Petaluma

- Park Place Well

City of Redding

- Foothill Water Treatment Plant Improvements

City of Roseville

- Dry Creek Trunk Sewer Bank Stabilization

City of Sacramento

- Oak Park Regional Storage Design
- Shasta Park Reservoir
- 9th Street Sewer Improvements

City of San Bruno

- Jenevein Ave Water and Sewer Replacement
- Pressure Regulating Stations
- San Mateo Ave Water and Sewer Replacement
- Tank No. 3 (Glenview) Replacement Project
- Trenton Sewer Replacement

City of San Jose

- Nordale Pump Station Design

City of St. Helena

- Stonebridge Wells Filter

City of Stockton

- 2015 Sanitary Sewer Rehabilitation, Alexandria Place
- 2015 Sanitary Sewer Rehabilitation, Black Oak
- 2015 Sanitary Sewer Rehabilitation, Navy Drive

City of Tracy

- Tracy Hills Booster Pump Station at JJWTP

City of Vacaville

- Lagoon Valley Lift Station Design Update

City of Woodland

- Woodland Well 28 (Well 1 Replacement)

Delta Diablo

- Bay Point Sewer Repairs
- Bay point Sewer Rehabilitation (Phase 3)
- Pittsburg Recycled Water System Expansion

First Solar

- (City of Rohnert Park) Tank 8 Schedule A&B
- Desert Stateline
- McCoy Solar
- McCoy Well Equipment Design
- Playa Solar

KB Homes

- West Roseville ASR Well

Lake Berryessa Resort Improvement District

- Water Storage and Disposal Expansion

Mt. View SD

- Influent Pump Station Improvement
- Trailer Mounted Pump and Accessories

Metropolitan Wastewater Management Commission

- Repair/Replacement of the Biosolids Force Main

Placer County Water Agency

- American River Pump Station Flow Enhancement

Placer County

- Saddleback Lift Station Improvements

Sacramento Area SD

- Rollingwood Blvd. (NEA-5) Sewer Relief

Selma-Kingsburg-Fowler CSD

- McCall Sewer R&R Urgent Repair

The Nature Conservancy

- Lower Consumnes River Floodplain Restoration, Denier II/Oneto Project

UC Davis

- Lift Station Improvements
- Wastewater Treatment Plant Improvements

Union Sanitary District

- Alvarado-Niles Sewer Rehabilitation
- Jarvis Avenue Sanitary Sewer Replacement
- Newark Backyard Sewer - Phase 1
- Newark Backyard Sanitary Sewer Relocation, Phase 2
- Newark Backyard Sewer, Phase 3
- Niles Boulevard Sewer Project
- Pine Street Easement Improvements
- Upper Hetch Hetchy Sewer Rehabilitation
- Wastewater Treatment Plant Facilities Improvements Sludge Degritter System

Wallace Group

- Taft Wastewater Treatment Plant Improvements

WP Development

- West Brook ASR Well Design

Local Business Enterprise (LBE) and Tax Certificates

ATTACHMENT #3

LOCAL BUSINESS ENTERPRISE (LBE) PREFERENCE FORM

1. LBE SELECTION PREFERENCE

The Sacramento City Council has adopted a Local Business Enterprise Preference program to provide enhanced opportunities for the participation of local business enterprises (LBEs) in the City's contracting and procurement activities. To receive this evaluation preference, a firm must be qualified prior to the submittal due date.

A Local Business Enterprise means a business enterprise, including but not limited to, a sole proprietorship, partnership, Limited Liability Company, corporation, or other business entity that has a legitimate business presence in the City of Sacramento or unincorporated County of Sacramento. Evidence of legitimate business presence shall be as follows:

a. Having a current City of Sacramento Business Operation Tax (BOTC) Number **or** a County of Sacramento Business License (CBL) Number; **and**

b. Having either of the following type of office or workspace operating legally within the City of Sacramento or the unincorporated County of Sacramento:

   i. The LBE's principle business office or workspace; or
   ii. The LBE's regional, branch, or satellite office with at least one full time employee.

2. LOCAL BUSINESS ENTERPRISE (LBE) DOCUMENTATION

Is the submitting firm qualified as a Local Business Enterprise? Check the appropriate box:

☒ **YES** - the firm submitting is qualified as a local business enterprise.

☐ **NO** - the firm submitting is not qualified as a local business enterprise.

If "YES", provide submitting firm's BOTC or CBL Number, and local office or workspace address*:

BOTC or CBL No.: **BOTC # 87522, Expires 12/31/16** (must be current)

LOCAL OFFICE OR WORKSPACE ADDRESS:

2725 Riverside Boulevard, Suite 5
Sacramento, CA 95818
916.504.4915

West Yost's current Business Operation Tax Certificate (BOTC) is shown on page 2.

* Address must be a local physical office or workspace address. This excludes P.O. Boxes.

Printed on 50% post-consumer paper July 11, 2016

City of Sacramento – Business Operations Tax Certificates

West Yost Associates

MUST BE POSTED IN CONSPICUOUS PLACE

City of SACRAMENTO

87522

87522

BUSINESS OPERATIONS TAX CERTIFICATE

		FROM Mo. Day Yr.	TO Mo. Day Yr.
Business Name	WEST YOST & ASSOCIATES		
Business Address	2725 RIVERSIDE BLVD 5		
Owner	YOST, JAMES A.	01/01/2016	12/31/2016
Type of Business	CIVIL/ENVIRONMENTAL ENGINEERS		
Tax Classification	402A		Expires

TOTAL PAID: $301.00

CITY OF SACRAMENTO

JAN 27 2016

PAID

VOID IF NOT VALIDATED

WEST YOST & ASSOCIATES
2020 RESEARCH PARK DR 100
DAVIS, CA 95618-6148

THIS STUB MAY BE FOLDED/DETACHED BEFORE POSTING

This certificate is not to be construed as a business license or imply that the City of Sacramento has investigated, or approves or recommends, the holder of this certificate. Any representation to the contrary is fraudulent. (This certificate must be renewed within 30 days of expiration).

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EXHIBIT B

PROFESSIONAL SERVICES AGREEMENT FOR DESIGN PROFESSIONALS

FEE SCHEDULE/MANNER OF PAYMENT

1. **CONTRACTOR's Compensation.** The total of all fees paid to the CONTRACTOR for the performance of all services set forth in Exhibit A, including normal revisions (hereafter the "Services"), and for all authorized Reimbursable Expenses, shall not exceed the total sum of $____933,510____.

2. **Billable Rates.**

   CONTRACTOR shall be paid for the performance of Services on an hourly rate, daily rate, flat fee, lump sum or other basis, as set forth in Attachment 1 to Exhibit B, attached hereto and incorporated herein.

3. **CONTRACTOR's Reimbursable Expenses.** Reimbursable Expenses shall be limited to actual expenditures of CONTRACTOR for expenses that are necessary for the proper completion of the Services and shall only be payable if specifically authorized in advance by CITY.

4. **Payments to CONTRACTOR.**

   A. Payments to CONTRACTOR shall be made within a reasonable time after receipt of CONTRACTOR's invoice, said payments to be made in proportion to services performed or as otherwise specified in Attachment 1 to Exhibit B. CONTRACTOR may request payment on a monthly basis. CONTRACTOR shall be responsible for the cost of supplying all documentation necessary to verify the monthly billings to the satisfaction of CITY.

   B. All invoices submitted by CONTRACTOR shall contain the following information:

      (1) Job Name
      (2) Description of services billed under this invoice, and overall status of project
      (3) Date of Invoice Issuance
      (4) Sequential Invoice Number
      (5) CITY's Purchase Order Number
      (6) Total Contract Amount
      (7) Amount of this Invoice (Itemize all Reimbursable Expenses)
      (8) Total Billed to Date
      (9) Total Remaining on Contract
      (10) Updated project schedule. This shall identify those steps that shall be taken to bring the project back on schedule if it is behind schedule.

   C. Items shall be separated into Services and Reimbursable Expenses. Billings that do not conform to the format outlined above shall be returned to CONTRACTOR for correction. CITY shall not be responsible for delays in payment to CONTRACTOR resulting from CONTRACTOR's failure to comply with the invoice format described above.

D. Requests for payment shall be sent to:

Department of Utilities
1395 35th Ave, Sacramento, CA 95822
Phone: (916) 808-7481 / Fax: (916) 808-1497

Attn: *Marc Lee*

5. **Additional Services.** Additional Services are those services related to the scope of services of CONTRACTOR set forth in Exhibit A but not anticipated at the time of execution of this Agreement. Additional Services shall be provided only when a Supplemental Agreement authorizing such Additional Services is approved by CITY in accordance with CITY's Supplemental Agreement procedures. CITY reserves the right to perform any Additional Services with its own staff or to retain other consultants to perform said Additional Services.

6. **Accounting Records of CONTRACTOR.** During performance of this Agreement and for a period of three (3) years after completing all Services and Additional Services hereunder, CONTRACTOR shall maintain all accounting and financial records related to this Agreement, including, but not limited to, records of CONTRACTOR's costs for all Services and Additional Services performed under this Agreement and records of CONTRACTOR's Reimbursable Expenses, in accordance with generally accepted accounting practices, and shall keep and make such records available for inspection and audit by representatives of the CITY upon reasonable written notice.

7. **Taxes.** CONTRACTOR shall pay, when and as due, any and all taxes incurred as a result of CONTRACTOR's compensation hereunder, including estimated taxes, and shall provide CITY with proof of such payment upon request. CONTRACTOR hereby agrees to indemnify CITY for any claims, losses, costs, fees, liabilities, damages or injuries suffered by CITY arising out of CONTRACTOR's breach of this Section 7.

WEST YOST ASSOCIATES

2016 Billing Rate Schedule

(Effective January 1, 2016 through December 31, 2016)*

Engineering

POSITION	LABOR CHARGES (DOLLARS PER HR)
Principal/Vice President	249
Engineering/Scientist/Geologist Manager II	239
Engineering/Scientist/Geologist Manager I	229
Principal Engineer/Scientist/Geologist II	222
Principal Engineer/Scientist/Geologist I	209
Senior Engineer/Scientist/Geologist II	196
Senior Engineer/Scientist/Geologist I	187
Associate Engineer/Scientist/Geologist II	177
Associate Engineer/Scientist/Geologist I	166
Engineer/Scientist/Geologist II	155
Engineer/Scientist/Geologist I	134
Senior GIS Analyst	183
GIS Analyst	172
CAD Supervisor	145
Senior CAD Designer	126
CAD Designer	112
Engineering Aide	76
Technical Specialist IV	142
Technical Specialist III	126
Technical Specialist II	109
Technical Specialist I	91
Administrative IV	114
Administrative III	104
Administrative II	86
Administrative I	68

- Technology and Communication charges including general and CAD computer, software, telephone, routine in-house copies/prints, postage, miscellaneous supplies, and other incidental project expenses will be billed at 6% of West Yost labor.
- Outside Services such as vendor reproductions, prints, shipping, and major West Yost reproduction efforts, as well as Engineering Supplies, Travel, etc. will be billed at actual cost plus 15%.
- Mileage will be billed at the current Federal Rate.
- Subconsultants will be billed at actual cost plus 10%.
- Expert witness, research, technical review, analysis, preparation and meetings billed at 150% of standard hourly rates. Expert witness testimony and depositions billed at 200% of standard hourly rates.
- A Finance Charge of 1.5% per month (an Annual Rate of 18%) on the unpaid balance will be added to invoice amounts if not paid within 45 days from the date of the invoice.

Continued on following page

* This schedule is updated annually

WEST YOST ASSOCIATES

2016 Billing Rate Schedule (continued)

(Effective January 1, 2016 through December 31, 2016)*

Construction Management

POSITION	LABOR CHARGES (DOLLARS PER HOUR)
Senior Construction Manager	237
Construction Manager IV	206
Construction Manager III	165
Construction Manager II	155
Construction Manager I	144
Resident Inspector (Prevailing Wage – Group 1)	161
Resident Inspector (Prevailing Wage – Group 2)	155
Resident Inspector (Prevailing Wage – Group 3)	139
Resident Inspector (Prevailing Wage – Group 4)	125
Apprentice Inspector	113
CM Administrative II	82
CM Administrative I	62

Surveying

POSITION	LABOR CHARGES (DOLLARS PER HR)
GPS, 3-Person	376
GPS, 2-Person	326
GPS, 1-Person	253
Survey Crew, 2-Person	276
Survey Crew, 1-Person	208

Equipment Charges

EQUIPMENT	BILLING RATE (DOLLARS PER DAY)	BILLING RATE (DOLLARS PER WEEK)
DO Meter	18	86
pH Meter	5	27
Automatic Sampler	135	740
Transducer/Data Logger	43	214
Hydrant Pressure Gage	12	52
Hydrant Pressure Recorder (HPR)	—	214
Hydrant Wrench	5	34
Well Sounder	30	139
Ultrasonic Flow Meter	—	280
Vehicle	92	463
Velocity Meter	12	68
Water Quality Multimeter	183	1003

* This schedule is updated annually

J Calton Engineering
City of Sac Shasta Park Water Facilities
Sept 16, 2014

		Electrical Inspection $150/hr John Calton	
Scope of Services (Taken from RFP Attachment 6)		**Hours**	**Subtotal**
Task 1	Constructability Review	16	$2,400
Task 2	Utility Coordination	2	$300
Task 3	Submittal review of major equipment only	32	$4,800
Task 3	Inspection services - elec and instr work, start-up, testing	160	$24,000
Task 3	Review of contractor requests for changes	16	$2,400
Task 3	Witness of electrical tests (Factory and Field)	16	$2,400
Task 3	Strive to detect and resolve problems or issues in field.	24	$3,600
Task 5	Ccoordinate electrical spare parts	4	$600
Task 5	Review as-builts - elec and instr	32	$4,800
	TOTAL	**302**	**$45,300.00**

Assumptions
1. Excludes inspection of underground structures

Auburn Main Office:
11521 Blocker Drive, Suite 110
Auburn, CA 95603
(530) 887-1494 Fax (530) 887-1495

West Sacramento Office:
2491 Boatman Avenue
West Sacramento, CA 95691
(916) 375-8706 Fax (916) 375-8709

blackburn consulting

www.blackburnconsulting.com

Modesto Office:
1016 12th Street
Modesto, CA 95354
(209) 522-6273

Fresno Office:
360 W. Bedford Avenue, Suite 101
Fresno, CA 93711
(559) 438-8411

Shasta Park Water Facility (CIP Z14005400)
2016 SCHEDULE OF FEES & SERVICES

Geotechnical ▪ Geo-Environmental ▪ Construction Services ▪ Forensics

PROFESSIONAL HOURLY RATES:

Project Engineer/Geologist I	$132	CAD/GIS	$124
Project Engineer/Geologist II	$142	Lab Aide	$77
Senior Engineer/Geologist	$158	Lab Manager	$132
Project Manager	$178	Technician Manager	$132
Senior Project Manager	$200	Clerical	$73
Principal	$226	Project Assistant	$96
Senior Principal	$252	Senior Administrative	$132
Expert Testimony & Deposition	$420		

SPECIAL INSPECTION PERSONNEL HOURLY RATES:

	Non-Prevailing Wage	Prevailing Wage
Group 1	$129	$156
ASNT Level II-III, DSA Shotcrete, Lead Inspector, NICET Level IV		
Group 2	$129	$150
AWS-CWI, ICC Certified Structural Inspector, NICET Level III, Shear Wall/Floor System Inspector, Building/Construction Inspector		
Group 3	$108	$128
Soils/Asphalt, Earthwork Grading, Excavation and Backfill, NICET Level II		
Group 4	$108	$128
ACI, ICC Fireproofing, NICET Level I, Proofload Testing, Torque Testing		

MINIMUM BASIC CHARGES:

Outside Equipment & Services	Cost plus 20%
Vehicle Charge	$0.54 per mile
Per Diem	Location specific, minimum $125 per night
Technician Services	Charge includes time from office and return to office, minimum charge - 2 hours
Overtime	Over 8 hours: 1.5 x Hourly Rate Before 7:00am or after 4:00pm: 1.5 x Hourly Rate Rush Charge (less than 24 hours notice): 1.5 x Hourly Rate Saturday: 1.5 x Hourly Rate (minimum: 4 hr. increments) Sunday & Holiday: 2.0 x Hourly Rate (minimum: 4 hr increments)
Report Copies	4 Report copies provided
Additional Report Copies	$100 for binding up to 50 pages, plus postage

EQUIPMENT: *(personnel not included)*

Hand Sampling Equipment	$237 / Day	Double Ring Infiltrometer Equipment	$278 / Day
Nuclear Moisture/Density Testing	$14 / Test	Liquid Level Equipment	$232 / Day
6" Sand Cone Testing	$36 / Test	Pachometer	$118 / Day
12" Sand Cone Testing	$180 / Test	Rock Point Load Test Equipment	$118 / Day
Coring Bit Charge	$36 / Core	Roto Hammer	$113 / Day
Coring Machine	$227 / Day	Schmidt Hammer	$93 / Day
Dynamic Cone Penetrometer	$258 / Day	Torque Wrench	$57 / Day
Electrical Resistivity Equipment	$227 / Day	Seismic Refraction:12 Channel	$443 / Day
Generator	$57 / Day	Traffic Control/Safety	$278 / Day
Groundwater Level Indicator	$57 / Day	Concrete Vapor Emission Test Kit	$24 / Ea
Inclinometer Survey Equipment	$567 / Day	pH Test Strip Package	$46 / Ea

Revised 11-09-15

Auburn Main Office:
11521 Blocker Drive, Suite 110
Auburn, CA 95603
(530) 887-1494 Fax (530) 887-1495

West Sacramento Office:
2491 Boatman Avenue
West Sacramento, CA 95691
(916) 375-8706 Fax (916) 375-8709

Modesto Office:
1016 12th Street
Modesto, CA 95354
(209) 522-6273

Fresno Office:
360 W. Bedford Avenue, Suite 101
Fresno, CA 93711
(559) 438-8411

www.blackburnconsulting.com

2016 LABORATORY FEE SCHEDULE

Geotechnical ▪ Geo-Environmental ▪ Construction Services ▪ Forensics

SOIL CLASSIFICATION		
#200 Sieve Wash	ASTM D1140	$113
Sieve Analysis to #200	ASTM D6913, CAL 202	$175
Standard Hydrometer with Sieve Analysis	ASTM D422	$345
Plasticity Index	ASTM D4318	$252
Specific Gravity - Soils	AASHTO T100	$108
MOISTURE / DENSITY		
Moisture Content	ASTM D2216, CAL 226	$41
Moisture/Density		$77
SOIL COMPACTION		
Standard Proctor (*4" or 6" mold*)	ASTM D698	$314
Modified Proctor (*4" or 6" mold*)	ASTM D1557	$314
California Impact	CAL 216	$314
Check Point (*Standard or Modified*)		$144
VOLUME CHANGE		
One-Dimensional Consolidation	ASTM D2435	$494
(6 load increments, includes 2 time rate curves and 2 rebound decrements)		
Additional Load or Rebound Decrement		$33/ea
Additional Time Rate Curves		$108/ea
Expansion Index	ASTM D4829	$258
Settlement Swell	ASTM D4546	$155
STRENGTH		
Unconfined Compression	ASTM D2166	$144
Compression, Rock *Prep & Photos included*	ASTM D7012	$273
Rock Point Load (up to six points)	ASTM D5731	$67
Compression Test of Cored Concrete Spec.		$77
California Bearing Ratio (CBR), with curve	ASTM D1883	$783
California Bearing Ratio (CBR), without curve	ASTM D1883	$469
Resistance Value	CAL 301, ASTM D2844	$340
Direct Shear: *(per point)*		
Undisturbed	ASTM D3080	$196
Remolded	ASTM D3080	$252
Triaxial Compression: *(per point) Photos of failure upon request*		
Undrained, Unconsolidated w/out Pore Pressure	ASTM D2850	$175
Consolidated, Undrained w/ Pore Pressure Measurements	ASTM D4767	$515
Consolidated, Drained		$742
Consolidated, Undrained, no Pore Pressure Measurements		$288
Specimen Remolding		$113

CORROSIVITY ANALYSIS		
Corrosion Analysis Package	CAL 643, 417, 422	$319
Includes Soil Resistivity, Soil pH, Sulfates / Chlorides. Minimum size is 1,000 grams		
pH	CTM643	$41
Resistivity	CTM643	$134
PERMEABILITY		
Flex-wall Permeability	ASTM D5084	
Either Constant head or Falling Head / rising Tail Water. Method depends on soil type		$453
Each Additional Effective Stress		$113
Specimen Remodeling		$113
TREATED SOIL TESTS		
% Lime for Stabilization - per point (%)	ASTM D6276	$124
pH of Soil	CTM643	$41
Modified Proctor	ASTM D1557	$376
Unconfined Compression Test	ASTM D5102	$211
One Dimensional Swell	ASTM D4546	$211
AGGREGATES		
Bulk Specific Gravity - Course & Fine Aggregate	ASTM C127 & 128, CAL 206, 207	$108
Coarse Durability	CAL 229	$185
Fine Durability	CAL 229	$185
Sand Equivalent	CAL 217, ASTM D2419	$129
Cleanness Value	CAL 227	$175
Moisture Content	CAL 226/370	$98
Percent of Crushed Particles (per size fraction)	CAL 205	$165
Fine Aggregate Angularity	AASHTO T304, Method A	$165
Flat and Elongated Particles (per size)	AASHTO D 4791	$165
Combined Grading 1" through no. 200	CAL 201/202	$175
Bin Grading (First 2 Bins)	CAL 201/202	$175
Each Bin Thereafter		$67
LP-9 (RAP) Burn	LP-9, CT382	$108
ASPHALT		
Bulk Specific Gravity - Compacted Hot Mix Asphalt	CAL 308	$52
Theoretical Max Specific Gravity (Rice)	CAL 309	$191
LTMD (Set of 5)	CAL 375	$381
Binder Content		
Ignition Oven Correction Factor	CAL 382	$324
Ignition Oven	CAL 382	$191
Solvent	AASHTO T164	$242
Stability (Set of 3)	CAL 366	$340
Void Content		
With Stability and Rice	CAL 367	$36
CONCRETE & MASONRY		
Concrete Compression Test 6" x 12" or 4" x 8"	ASTM C39	$36
Masonry or Grout Compression		$52

Other Tests Quoted Upon Request

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Shasta Park Water Facility
CIP Z14005400
Sacramento Department of Utilities

July 21, 2016 — BCI File No. 2753.x

Task	Item	Quantity	Rate	Unit	Mult.	Item cost	Task Subtotal
Review Plans & Specifications- Pre-Construction Meeting	Sr. Project Manager	8	$200	hour	1	$1,600	
	Technician Manager	8	$132	hour	1	$1,056	
	Grp 3 - Non Prevailing Wage	4	$108	hour	1	$432	
	Senior Administrative	4	$132	hour	1	$528	
							$3,616
Structures							
Booster Pump Station	Sr. Project Manager	2	$200	hour	1	$400	
Concrete, Backfill, Subgrade	Technician Manager	4	$132	hour	1	$528	
	Grp 3 - Non Prevailing Wage	15	$108	hour	1	$1,620	
Observation / Testing	Grp 3 - Prevailing Wage	45	$128	hour	1	$5,760	
	Nuclear Density Tests	44	$14	test	1	$616	
	Concrete Cylinders	20	$36	ea	1	$720	
	Concrete Pickup	4	$108	hour	1	$432	
	Mileage	53	$0.54	mile	1	$29	
							$10,105
Drainage/Dewatering Pump Sta.	Sr. Project Manager	1	$200	hour	1	$200	
Concrete, Backfill, Subgrade	Technician Manager	2	$132	hour	1	$264	
	Grp 3 - Non Prevailing Wage	6	$108	hour	1	$648	
Observation / Testing	Grp 3 - Prevailing Wage	12	$128	hour	1	$1,536	
	Nuclear Density Tests	23	$14	test	1	$322	
	Concrete Cylinders	5	$36	ea	1	$180	
	Concrete Pickup	1	$108	hour	1	$108	
	Mileage	196	$0.85	mile	1	$167	
							$3,425
Aerator Tank and Pump Sta.	Sr. Project Manager	1	$200	hour	1	$200	
Concrete, Backfill, Subgrade	Technician Manager	2	$132	hour	1	$264	
	Grp 3 - Non Prevailing Wage	10	$108	hour	1	$1,080	
Observation / Testing	Grp 3 - Prevailing Wage	30	$128	hour	1	$3,840	
	Nuclear Density Tests	48	$14	test	1	$672	
	Concrete Cylinders	20	$36	ea	1	$720	
	Concrete Pickup	4	$108	hour	1	$432	
	Mileage	392	$0.85	mile	1	$333	
							$7,541
Control Building	Sr. Project Manager	1	$200	hour	1	$200	
Concrete, Subgrade, Masonry	Technician Manager	3	$132	hour	1	$396	
	Grp 3 - Non Prevailing Wage	9	$108	hour	1	$972	
	Grp 3 - Prevailing Wage	6	$128	hour	1	$768	
	Grp 2 - Prevailing Wage	48	$150	hour	1	$7,200	
Observation / Testing	Nuclear Density Tests	6	$14	test	1	$84	
	Concrete Cylinders	10	$36	ea	1	$360	
	Grout and Mortar Samples	18	$52	ea	1	$936	
	Mileage	588	$0.85	mile	1	$500	
							$11,416

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Task	Item	Quantity	Rate	Unit	Mult.	Item cost	Task Subtotal
Filter Foundation	Sr. Project Manager	1	$200	hour	1	$200	
Concrete, Subgrade	Technician Manager	1	$132	hour	1	$132	
	Grp 3 - Non Prevailing Wage	2	$108	hour	1	$216	
Observation / Testing	Grp 3 - Prevailing Wage	4	$128	hour	1	$512	
	Nuclear Density Tests	3	$14	test	1	$42	
	Concrete Cylinders	5	$36	ea	1	$180	
	Concrete Pickup	2	$108	hour	1	$216	
	Mileage	112	$0.85	mile	1	$95	
							$1,593
Backwash Tank	Technician Manager	1	$132	hour	1	$132	
Concrete, Subgrade	Grp 3 - Non Prevailing Wage	2	$108	hour	1	$216	
	Grp 3 - Prevailing Wage	4	$128	hour	1	$512	
Observation / Testing	Nuclear Density Tests	8	$14	test	1	$112	
	Concrete Cylinders	5	$36	ea	1	$180	
	Concrete Pickup	1	$108	hour	1	$108	
	Mileage	84	$0.85	mile	1	$71	
							$1,331
4MG Concrete Tank	Sr. Project Manager	3	$200	hour	1	$600	
Concrete, Backfill, Subgrade	Technician Manager	6	$132	hour	1	$792	
	Grp 3 - Non Prevailing Wage	27	$108	hour	1	$2,916	
Observation / Testing	Grp 3 - Prevailing Wage	81	$128	hour	1	$10,368	
	Nuclear Density Tests	125	$14	test	1	$1,750	
	Concrete Cylinders	100	$36	ea	1	$3,600	
	Concrete Pickup	20	$108	hour	1	$2,160	
	Mileage	1316	$0.85	mile	1	$1,119	
							$23,305
Transformer Pad	Technician Manager	0.5	$132	hour	1	$66	
Concrete, Subgrade	Grp 3 - Non Prevailing Wage	2	$108	hour	1	$216	
	Grp 3 - Prevailing Wage	4	$132	hour	1	$528	
Observation / Testing	Nuclear Density Tests	4	$14	test	1	$56	
	Concrete Cylinders	4	$36	ea	1	$144	
	Concrete Pickup	1	$108	hour	1	$108	
	Mileage	84	$0.85	mile	1	$71	
							$1,189
Yard Piping & Underground	Sr. Project Manager	2	$200	hour	1	$400	
Trench Backfill	Technician Manager	5	$132	hour	1	$660	
	Grp 3 - Non Prevailing Wage	12	$108	hour	1	$1,296	
Observation / Testing	Grp 3 - Prevailing Wage	24	$128	hour	1	$3,072	
Storm Drain, Sewer, Water	Nuclear Density Tests	84	$14	test	1	$1,176	
	Mileage	336	$0.85	mile	1	$286	
							$6,890
Surface Improvements	Sr. Project Manager	1	$200	hour	1	$200	
Subgrade, AB, HMA	Technician Manager	2	$132	hour	1	$264	
	Grp 3 - Non Prevailing Wage	6	$108	hour	1	$648	
Observation / Testing	Grp 3 - Prevailing Wage	24	$128	hour	1	$3,072	
	Nuclear Density Tests	68	$14	test	1	$952	
	Mileage	168	$0.85	mile	1	$143	
							$5,279

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Task	Item	Quantity	Rate	Unit	Mult.	Item cost	Task Subtotal
Miscellaneous Concrete	Technician Manager	0.5	$132	hour	1	$66	
Concrete	Grp 3 - Non Prevailing Wage	4	$108	hour	1	$432	
	Grp 3 - Prevailing Wage	8	$128	hour	1	$1,024	
Observation / Testing	Concrete Cylinders	16	$36	ea	1	$576	
	Concrete Pickup	4	$108	hour	1	$432	
	Mileage	224	$0.85	mile	1	$190	
							$2,720
Post Installed anchors	Sr. Project Manager	1	$200	hour	1	$200	
	Technician Manager	3	$132	hour	1	$396	
Observation	Grp 3 - Non Prevailing Wage	6	$108	hour	1	$648	
	Grp 2 - Prevailing Wage	12	$150	hour	1	$1,800	
	Mileage	168	$0.85	mile	1	$143	
							$3,187
Welding Inspection	Sr. Project Manager	2	$200	hour	1	$400	
	Technician Manager	4	$132	hour	1	$528	
Observation	Grp 3 - Non Prevailing Wage	10	$108	hour	1	$1,080	
	Grp 2 - Prevailing Wage	60	$150	hour	1	$9,000	
	Mileage	280	$0.85	mile	1	$238	
							$11,246
Laboratory Testing	ASTM 6913 - Sieve analysis	12	$175	test	1	$2,100	
Soil, Agg. Base, PCC Agg.,	ASTM 4318- Plasticity Index	6	$252	test	1	$1,512	
Crushed Rock Bedding,	ASTM 698/1557 - Proctor	12	$314	test	1	$3,768	
Sand Bedding, HMA AGG, &	CTM 301 R-Value	2	$340	test	1	$680	
HMA	CTM 309 Max. Theoretical	1	$191	test	1	$191	
	ASTM 2419 - Sand Equivalent	6	$129	test	1	$774	
							$9,025
					Total Estimated Fee		$101,867

West Yost Associates PROJECT: Shasta Park Water Facility	Principal/Vice President P/VP $249	Construction Manager III CM III $165 Jack Harbour	Construction Manager II (Alternate) CM II $155 J.P. Davis*	Resident Inspector (Prevailing Wage – Group 2) RI_G2 $155 Tom Lake	Technical Specialist II TS II $109 Kristen Burris	Technical Specialist II (Alternate) TS II $109 Max Colorado**	Labor Hours	Labor Fee	Technology & Admin 6%	Sub. JCE DETAILED	Sub. BCI DETAILED	Costs Sub. w/ markup 10%	Costs Other Direct	Costs Total Costs
Task 1 CM Services Before Construction														
1.1 Contract Plan and Specification/Constructability Review	4	40					44	$ 7,596	$ 456	$ 2,400		$ 2,640		$ 10,692
1.2 Preliminary Project Schedule		24					24	$ 3,960	$ 238					$ 4,198
1.3 Document Control Training					8		8	$ 872	$ 52					$ 924
1.4 Pre-Construction Conference	2	8					10	$ 1,818	$ 109					$ 1,927
1.5 Documentation of Existing Site Conditions		16					16	$ 2,640	$ 158					$ 2,798
Subtotal, Task 1 (hours)	**6**	**88**	**0**	**0**	**8**	**0**	**102**							
Subtotal, Task 1 ($)	**$ 1,494**	**$ 14,520**			**$ 872**			**$ 16,886**	**$ 1,013**	**$ 2,400**		**$ 2,640**		**$ 20,539**
Task 2 CM Services During Construction														
2.1 Utility Relocation Coordination, Observation/Monitoring		40					40	$ 6,600	$ 396	$ 300		$ 330		$ 7,326
Subtotal, Task 2 (hours)	**0**	**40**	**0**	**0**	**0**	**0**	**40**							
Subtotal, Task 2 ($)		**$ 6,600**						**$ 6,600**	**$ 396**	**$ 300**		**$ 330**		**$ 7,326**
Task 3 CM Services During Construction														
3.1 Project Coordination and Correspondence	80	260			120		460	$ 75,900	$ 4,554					$ 80,454
3.2 Schedule Management, Progress Meetings and Reports		200			360		560	$ 72,240	$ 4,334					$ 76,574
3.3 Payment Recommendations		80			90		170	$ 23,010	$ 1,381					$ 24,391
3.4 Submittals Management		50			400		450	$ 51,850	$ 3,111					$ 54,961
3.5 Requests For Information (RFI)		50			222		272	$ 32,448	$ 1,947					$ 34,395
3.6 Change Orders and Claims		160			60		220	$ 32,940	$ 1,976					$ 34,916
3.7 Construction Observation/Inspection Services	80	1107		1000			2187	$ 357,575	$ 21,455	$ 14,400		$ 15,840		$ 394,870
3.8 Quality Assurance Testing							0				$ 99,671	$ 109,638		$ 109,638
Subtotal, Task 3 (hours)	**160**	**1907**	**0**	**1000**	**1252**	**0**	**4319**							
Subtotal, Task 3 ($)	**$ 39,840**	**$ 314,655**		**$ 155,000**	**$ 136,468**			**$ 645,963**	**$ 38,758**	**$ 14,400**	**$ 99,671**	**$ 125,478**		**$ 810,199**
Task 4 Construction Staking														
4.1 Construction Staking (2-Person Crew)							0							
Subtotal, Task 4 (hours)	**0**	**0**	**0**	**0**	**0**	**0**	**0**							
Subtotal, Task 4 ($)														
Task 5 Post-Construction Services														
5.1 Final Inspection, Punch List, and Notice of Completion	8	40		40	40		128	$ 19,152	$ 1,149	$ 1,200		$ 1,320		$ 21,621
Subtotal, Task 5 (hours)	**8**	**40**	**0**	**40**	**40**	**0**	**128**							
Subtotal, Task 5 ($)	**$ 1,992**	**$ 6,600**		**$ 6,200**	**$ 4,360**			**$ 19,152**	**$ 1,149**	**$ 1,200**		**$ 1,320**		**$ 21,621**
Task 6 Contingency Budget														
6.1 Additional CM Services		305					305	$ 50,325	$ 3,020					$ 53,345
Subtotal, Task 6 (hours)	**0**	**305**	**0**	**0**	**0**	**0**	**305**							
Subtotal, Task 6 ($)		**$ 50,325**						**$ 50,325**	**$ 3,020**					**$ 53,345**
Task 7 ODCs														
7.1 Vehicle							0						$ 20,480	$ 20,480
Subtotal, Task 7 (hours)	**0**	**0**	**0**	**0**	**0**	**0**	**0**							
Subtotal, Task 7 ($)													**$ 20,480**	**$ 20,480**
TOTAL (hours)	**174**	**2,380**	**0**	**1,040**	**1,300**	**0**	**4,894**							
TOTAL ($)	**$ 43,326**	**$ 392,700**		**$ 161,200**	**$ 141,700**			**$ 738,926**	**$ 44,336**	**$ 18,300**	**$ 99,671**	**$ 129,768**	**$ 20,480**	**$ 933,510**

* Alternate staff member for Construction Manager & Resident Inspector positions.
** Alternate staff member for Administrative Assistant position

WEST YOST ASSOCIATES

EXHIBIT C

PROFESSIONAL SERVICES AGREEMENT FOR DESIGN PROFESSIONALS

FACILITIES AND EQUIPMENT TO BE PROVIDED BY CITY

CITY shall [*check one*] _____ Not furnish any facilities or equipment for this Agreement;

or

✓ Furnish the following facilities or equipment for the Agreement [*list, if applicable*]:

Per the construction contract, Field Offices will be provided by the construction contractor at the work site.

EXHIBIT D

PROFESSIONAL SERVICES AGREEMENT FOR DESIGN PROFESSIONALS

GENERAL PROVISIONS

1. Independent Contractor.

A. It is understood and agreed that CONTRACTOR (including CONTRACTOR's employees) is an independent contractor and that no relationship of employer-employee exists between the parties hereto for any purpose whatsoever. Neither CONTRACTOR nor CONTRACTOR's assigned personnel shall be entitled to any benefits payable to employees of CITY. CITY is not required to make any deductions or withholdings from the compensation payable to CONTRACTOR under the provisions of this Agreement, and CONTRACTOR shall be issued a Form 1099 for its services hereunder. As an independent contractor, CONTRACTOR hereby agrees to indemnify and hold CITY harmless from any and all claims that may be made against CITY based upon any contention by any of CONTRACTOR's employees or by any third party, including but not limited to any state or federal agency, that an employer-employee relationship or a substitute therefor exists for any purpose whatsoever by reason of this Agreement or by reason of the nature and/or performance of any Services under this Agreement. (As used in this Exhibit D, the term "Services" shall include both Services and Additional Services as such terms are defined elsewhere in this Agreement.)

B. It is further understood and agreed by the parties hereto that CONTRACTOR, in the performance of its obligations hereunder, is subject to the control and direction of CITY as to the designation of tasks to be performed and the results to be accomplished under this Agreement, but not as to the means, methods, or sequence used by CONTRACTOR for accomplishing such results. To the extent that CONTRACTOR obtains permission to, and does, use CITY facilities, space, equipment or support services in the performance of this Agreement, this use shall be at the CONTRACTOR's sole discretion based on the CONTRACTOR's determination that such use will promote CONTRACTOR's efficiency and effectiveness. Except as may be specifically provided elsewhere in this Agreement, the CITY does not require that CONTRACTOR use CITY facilities, equipment or support services or work in CITY locations in the performance of this Agreement.

C. If, in the performance of this Agreement, any third persons are employed by CONTRACTOR, such persons shall be entirely and exclusively under the direction, supervision, and control of CONTRACTOR. Except as may be specifically provided elsewhere in this Agreement, all terms of employment, including hours, wages, working conditions, discipline, hiring, and discharging, or any other terms of employment or requirements of law, shall be determined by CONTRACTOR. It is further understood and agreed that CONTRACTOR shall issue W-2 or 1099 Forms for income and employment tax purposes, for all of CONTRACTOR's assigned personnel and subcontractors.

D. The provisions of this Section 1 shall survive any expiration or termination of this Agreement. Nothing in this Agreement shall be construed to create an exclusive relationship between CITY and CONTRACTOR. CONTRACTOR may represent, perform

services for, or be employed by such additional persons or companies as CONTRACTOR sees fit provided that CONTRACTOR does not violate the provisions of Section 5, below.

2. **Licenses; Permits, Etc.** CONTRACTOR represents and warrants that CONTRACTOR has all licenses, permits, City Business Operations Tax Certificate, qualifications, and approvals of whatsoever nature that are legally required for CONTRACTOR to practice its profession or provide any services under the Agreement. CONTRACTOR represents and warrants that CONTRACTOR shall, at its sole cost and expense, keep in effect or obtain at all times during the term of this Agreement any licenses, permits, and approvals that are legally required for CONTRACTOR to practice its profession or provide such Services. Without limiting the generality of the foregoing, if CONTRACTOR is an out-of-state corporation, CONTRACTOR warrants and represents that it possesses a valid certificate of qualification to transact business in the State of California issued by the California Secretary of State pursuant to Section 2105 of the California Corporations Code.

3. **Time.** CONTRACTOR shall devote such time and effort to the performance of Services pursuant to this Agreement as is necessary for the satisfactory and timely performance of CONTRACTOR's obligations under this Agreement. Neither party shall be considered in default of this Agreement, to the extent that party's performance is prevented or delayed by any cause, present or future, that is beyond the reasonable control of that party.

4. **CONTRACTOR Not Agent.** Except as CITY may specify in writing, CONTRACTOR and CONTRACTOR's personnel shall have no authority, express or implied, to act on behalf of CITY in any capacity whatsoever as an agent. CONTRACTOR and CONTRACTOR's personnel shall have no authority, express or implied, to bind CITY to any obligations whatsoever.

5. **Conflicts of Interest.** CONTRACTOR covenants that neither it, nor any officer or principal of its firm, has or shall acquire any interest, directly or indirectly, that would conflict in any manner with the interests of CITY or that would in any way hinder CONTRACTOR's performance of Services under this Agreement. CONTRACTOR further covenants that in the performance of this Agreement, no person having any such interest shall be employed by it as an officer, employee, agent or subcontractor, without the written consent of CITY. CONTRACTOR agrees to avoid conflicts of interest or the appearance of any conflicts of interest with the interests of CITY at all times during the performance of this Agreement. If CONTRACTOR is or employs a former officer or employee of the CITY, CONTRACTOR and any such employee(s) shall comply with the provisions of Sacramento City Code Section 2.16.090 pertaining to appearances before the City Council or any CITY department, board, commission or committee.

6. **Confidentiality of CITY Information.** During performance of this Agreement, CONTRACTOR may gain access to and use CITY information regarding inventions, machinery, products, prices, apparatus, costs, discounts, future plans, business affairs, governmental affairs, processes, trade secrets, technical matters, systems, facilities, customer lists, product design, copyright, data, and other vital information (hereafter collectively referred to as "City Information") that are valuable, special and unique assets of the CITY. CONTRACTOR agrees to protect all City Information and treat it as strictly confidential, and further agrees that CONTRACTOR shall not at any time, either directly or indirectly, divulge, disclose or communicate in any manner any City Information to any third party without the prior written consent of CITY. In addition, CONTRACTOR shall comply with all CITY policies governing the use of the CITY network and

technology systems, as set forth in applicable provisions of the City of Sacramento Administrative Policy Instructions # 30. A violation by CONTRACTOR of this Section 6 shall be a material violation of this Agreement and shall justify legal and/or equitable relief.

7. CONTRACTOR Information.

A. CITY shall have full ownership and control, including ownership of any copyrights, of all information prepared, produced, or provided by CONTRACTOR pursuant to this Agreement. In this Agreement, the term "information" shall be construed to mean and include: any and all work product, submittals, reports, plans, specifications, and other deliverables consisting of documents, writings, handwritings, typewriting, printing, photostatting, photographing, computer models, and any other computerized data and every other means of recording any form of information, communications, or representation, including letters, works, pictures, drawings, sounds, or symbols, or any combination thereof. CONTRACTOR shall not be responsible for any unauthorized modification or use of such information for other than its intended purpose by CITY.

B. CONTRACTOR shall fully defend, indemnify and hold harmless CITY, its officers and employees, and each and every one of them, from and against any and all claims, actions, lawsuits or other proceedings alleging that all or any part of the information prepared, produced, or provided by CONTRACTOR pursuant to this Agreement infringes upon any third party's trademark, trade name, copyright, patent or other intellectual property rights. CITY shall make reasonable efforts to notify CONTRACTOR not later than ten (10) days after CITY is served with any such claim, action, lawsuit or other proceeding, provided that CITY's failure to provide such notice within such time period shall not relieve CONTRACTOR of its obligations hereunder, which shall survive any termination or expiration of this Agreement.

C. All proprietary and other information received from CONTRACTOR by CITY, whether received in connection with CONTRACTOR's proposal to CITY or in connection with any Services performed by CONTRACTOR, will be disclosed upon receipt of a request for disclosure, pursuant to the California Public Records Act; provided, however, that, if any information is set apart and clearly marked "trade secret" when it is provided to CITY, CITY shall give notice to CONTRACTOR of any request for the disclosure of such information. The CONTRACTOR shall then have five (5) days from the date it receives such notice to enter into an agreement with the CITY, satisfactory to the City Attorney, providing for the defense of, and complete indemnification and reimbursement for all costs (including plaintiff's attorney fees) incurred by CITY in any legal action to compel the disclosure of such information under the California Public Records Act. The CONTRACTOR shall have sole responsibility for defense of the actual "trade secret" designation of such information.

D. The parties understand and agree that any failure by CONTRACTOR to respond to the notice provided by CITY and/or to enter into an agreement with CITY, in accordance with the provisions of subsection C, above, shall constitute a complete waiver by CONTRACTOR of any rights regarding the information designated "trade secret" by CONTRACTOR, and such information shall be disclosed by CITY pursuant to applicable procedures required by the Public Records Act.

8. **Standard of Performance.** CONTRACTOR shall perform all Services required pursuant to this Agreement in the manner and according to the standards currently observed by a competent practitioner of CONTRACTOR's profession in California. All products of whatsoever nature that CONTRACTOR delivers to CITY pursuant to this Agreement shall be prepared in a professional manner and conform to the standards of quality normally observed by a person currently practicing in CONTRACTOR's profession, and shall be provided in accordance with any schedule of performance specified in Exhibit A. CONTRACTOR shall assign only competent personnel to perform Services pursuant to this Agreement. CONTRACTOR shall notify CITY in writing of any changes in CONTRACTOR's staff assigned to perform the Services required under this Agreement, prior to any such performance. In the event that CITY, at any time during the term of this Agreement, desires the removal of any person assigned by CONTRACTOR to perform Services pursuant to this Agreement, because CITY, in its sole discretion, determines that such person is not performing in accordance with the standards required herein, CONTRACTOR shall remove such person immediately upon receiving notice from CITY of the desire of CITY for the removal of such person.

9. **Term; Suspension; Termination.**

A. This Agreement shall become effective on the date that it is approved by both parties, set forth on the first page of the Agreement, and shall continue in effect until both parties have fully performed their respective obligations under this Agreement, unless sooner terminated as provided herein.

B. CITY shall have the right at any time to temporarily suspend CONTRACTOR's performance hereunder, in whole or in part, by giving a written notice of suspension to CONTRACTOR. If CITY gives such notice of suspension, CONTRACTOR shall immediately suspend its activities under this Agreement, as specified in such notice.

C. CITY shall have the right to terminate this Agreement at any time by giving a written notice of termination to CONTRACTOR. If CITY gives such notice of termination, CONTRACTOR shall immediately cease rendering Services pursuant to this Agreement. If CITY terminates this Agreement:

(1) CONTRACTOR shall, not later than five days after such notice of termination, deliver to CITY copies of all information prepared pursuant to this Agreement.

(2) CITY shall pay CONTRACTOR the reasonable value of Services rendered by CONTRACTOR prior to termination; provided, however, CITY shall not in any manner be liable for lost profits that might have been made by CONTRACTOR had the Agreement not been terminated or had CONTRACTOR completed the Services required by this Agreement. In this regard, CONTRACTOR shall furnish to CITY such financial information as in the judgment of the CITY is necessary for CITY to determine the reasonable value of the Services rendered by CONTRACTOR. The foregoing is cumulative and does not affect any right or remedy that CITY may have in law or equity.

10. Indemnity.

A. Indemnity: CONTRACTOR shall defend, hold harmless and indemnify CITY, its officers and employees, and each and every one of them, from and against any and all claims, actions, damages, costs, liabilities, demands, losses, judgments, penalties and expenses of every type and description, including, but not limited to, any fees and/or costs reasonably incurred by CITY's staff attorneys or outside attorneys and any fees and expenses incurred in enforcing this provision (hereafter collectively referred to as "Claims"), including but not limited to Claims arising from personal injury or death, damage to personal, real, or intellectual property, or the environment, contractual or other economic damages, or regulatory penalties, that arise out of, pertain to, or relate to any negligent act or omission, recklessness, or willful misconduct of CONTRACTOR, its sub-consultants, subcontractors, or agents, and their respective officers and employees, in connection with performance of or failure to perform this Agreement, whether or not such Claims are litigated, settled, or reduced to judgment; provided that the foregoing indemnity does not apply to liability for damages for death or bodily injury to persons, injury to property, or other loss, damage, or expense to the extent arising from (i) the sole negligence or willful misconduct of, or defects in design furnished by, CITY, its agents, servants, or independent contractors who are directly responsible to CITY, or (ii) the active negligence of CITY.

B. Insurance Policies; Intellectual Property Claims: The existence or acceptance by CITY of any of the insurance policies or coverages described in this Agreement shall not affect or limit any of CITY's rights under this Section 10, nor shall the limits of such insurance limit the liability of CONTRACTOR hereunder. This Section 10 shall not apply to any intellectual property claims, actions, lawsuits, or other proceedings subject to the provisions of Section 7.B., above. The provisions of this Section 10 shall survive any expiration or termination of this Agreement.

11. Insurance Requirements. During the entire term of this Agreement, CONTRACTOR shall maintain the insurance coverage described in this Section 11.

Full compensation for all premiums that CONTRACTOR is required to pay for the insurance coverage described herein shall be included in the compensation specified for the Services provided by CONTRACTOR under this Agreement. No additional compensation will be provided for CONTRACTOR's insurance premiums. Any available insurance proceeds in excess of the specified minimum limits and coverages shall be available to the CITY.

It is understood and agreed by the CONTRACTOR that its liability to the CITY shall not in any way be limited to or affected by the amount of insurance coverage required or carried by the CONTRACTOR in connection with this Agreement.

A. Minimum Scope & Limits of Insurance Coverage

(1) Commercial General Liability Insurance providing coverage at least as broad as ISO CGL Form 00 01 on an occurrence basis for bodily injury, including death, of one or more persons, property damage, and personal injury, arising out of activities performed by or on behalf of CONTRACTOR, its sub-consultants, and

subcontractors, products and completed operations of CONTRACTOR, its sub-consultants, and subcontractors, and premises owned, leased, or used by CONTRACTOR, its sub-consultants, and subcontractors, with limits of not less than one million dollars ($1,000,000) per occurrence. The policy shall provide contractual liability and products and completed operations coverage for the term of the policy.

(2) Automobile Liability Insurance providing coverage at least as broad as ISO Form CA 00 01 for bodily injury, including death, of one or more persons, property damage, and personal injury, with limits of not less than one million dollars ($1,000,000) per accident. The policy shall provide coverage for owned, non-owned, and/or hired autos as appropriate to the operations of the CONTRACTOR.

No automobile liability insurance shall be required if CONTRACTOR completes the following certification:

> "I certify that a motor vehicle will not be used in the performance of any work or services under this agreement." _____ (CONTRACTOR initials)

(3) Workers' Compensation Insurance with statutory limits, and Employers' Liability Insurance with limits of not less than one million dollars ($1,000,000). The Workers' Compensation policy shall include a waiver of subrogation in favor of the CITY. If no work or services will be performed on or at CITY facilities or CITY Property, the CITY Representative may waive this requirement by selecting the option below:

> Workers' Compensation waiver of subrogation in favor of the CITY is not required. _____ (CITY Representative initials)

No Workers' Compensation insurance shall be required if CONTRACTOR completes the following certification:

> "I certify that my business has no employees, and that I do not employ anyone. I am exempt from the legal requirements to provide Workers' Compensation insurance." _____ (CONTRACTOR initials)

(4) Professional Liability Insurance providing coverage on a claims made basis for errors, omissions, or malpractice with limits of not less than one million ($1,000,000) dollars. Professional Liability (Errors and Omissions) insurance:

Is ✓ Is not _____ *[check one]* required for this Agreement.

If required, such coverage must be continued for at least 3 year(s) following the completion of all Services and Additional Services under this Agreement. The retroactive date must be prior to the date this Agreement is approved or any Services are performed.

B. Additional Insured Coverage

(1) Commercial General Liability Insurance: The CITY, its officials, employees, and volunteers shall be covered by policy terms or endorsement as additional insureds as respects general liability arising out of: activities performed by or on behalf of CONTRACTOR, its sub-consultants, and subcontractors; products and completed operations of CONTRACTOR, its sub-consultants, and subcontractors; and premises owned, leased, or used by CONTRACTOR, its sub-consultants, and subcontractors.

(2) Automobile Liability Insurance: The CITY, its officials, employees, and volunteers shall be covered by policy terms or endorsement as additional insureds as respects auto liability.

C. Other Insurance Provisions

The policies are to contain, or be endorsed to contain, the following provisions:

(1) Except for professional liability, CONTRACTOR's insurance coverage, including excess insurance, shall be primary insurance as respects CITY, its officials, employees, and volunteers. Any insurance or self-insurance maintained by CITY, its officials, employees, or volunteers shall be in excess of CONTRACTOR's insurance and shall not contribute with it.

(2) Any failure to comply with reporting provisions of the policies shall not affect coverage provided to CITY, its officials, employees, or volunteers.

(3) Coverage shall state that CONTRACTOR's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

(4) CITY will be provided with thirty (30) days written notice of cancellation or material change in the policy language or terms.

D. Acceptability of Insurance

Insurance shall be placed with insurers with a Bests' rating of not less than A:VI. Self-insured retentions, policy terms or other variations that do not comply with the requirements of this Section 11 must be declared to and approved by the CITY in writing prior to execution of this Agreement.

E. Verification of Coverage

(1) CONTRACTOR shall furnish CITY with certificates and required endorsements evidencing the insurance required. The certificates and endorsements shall be forwarded to the CITY representative named in Exhibit A. Copies of policies shall be delivered to the CITY on demand. Certificates of insurance shall be signed by an authorized representative of the insurance carrier.

(2) For all insurance policy renewals during the term of this Agreement, CONTRACTOR shall send insurance certificates reflecting the policy renewals directly to:

City of Sacramento
c/o Ebix RCS
Reference #: (This number will be provided by EBIX after Agreement approval.)
PO Box 257
Portland, MI 48875-0257

Insurance certificates also may be faxed to (770) 325-3340, or e-mailed to: CertsOnly-Portland@ebix.com

(3) The CITY may withdraw its offer of contract or cancel this Agreement if the certificates of insurance and endorsements required have not been provided prior to execution of this Agreement. The CITY may withhold payments to CONTRACTOR or cancel the Agreement if the insurance is canceled or CONTRACTOR otherwise ceases to be insured as required herein.

F. Subcontractors

CONTRACTOR shall require and verify that all sub-consultants and subcontractors maintain insurance coverage that meets the minimum scope and limits of insurance coverage specified in subsection A, above.

12. Equal Employment Opportunity. During the performance of this Agreement, CONTRACTOR, for itself, its assignees and successors in interest, agrees as follows:

A. Compliance With Regulations: CONTRACTOR shall comply with the Executive Order 11246 entitled "Equal Opportunity in Federal Employment", as amended by Executive Order 11375 and 12086, and as supplemented in Department of Labor regulations (41 CFR Chapter 60), hereinafter collectively referred to as the "Regulations".

B. Nondiscrimination: CONTRACTOR, with regards to the work performed by it after award and prior to completion of the work pursuant to this Agreement, shall not discriminate on the ground of race, color, religion, sex, national origin, age, marital status, physical handicap or sexual orientation in selection and retention of subcontractors, including procurement of materials and leases of equipment. CONTRACTOR shall not participate either directly or indirectly in discrimination prohibited by the Regulations.

C. Solicitations for Subcontractors, Including Procurement of Materials and Equipment: In all solicitations either by competitive bidding or negotiations made by CONTRACTOR for work to be performed under any subcontract, including all procurement of materials or equipment, each potential subcontractor or supplier shall be notified by CONTRACTOR of CONTRACTOR's obligation under this Agreement and the Regulations relative to nondiscrimination on the ground of race, color, religion, sex, national origin, age, marital status, physical handicap or sexual orientation.

D. Information and Reports: CONTRACTOR shall provide all information and reports required by the Regulations, or by any orders or instructions issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information and its facilities as may be determined by the CITY to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of CONTRACTOR is in the exclusive possession of another who fails or refuses to furnish this information, CONTRACTOR shall so certify to the CITY, and shall set forth what efforts it has made to obtain the information.

E. Sanctions for Noncompliance: In the event of noncompliance by CONTRACTOR with the nondiscrimination provisions of this Agreement, the CITY shall impose such sanctions as it may determine to be appropriate including, but not limited to:

(1) Withholding of payments to CONTRACTOR under this Agreement until CONTRACTOR complies;

(2) Cancellation, termination, or suspension of the Agreement, in whole or in part.

F. Incorporation of Provisions: CONTRACTOR shall include the provisions of subsections A through E, above, in every subcontract, including procurement of materials and leases of equipment, unless exempted by the Regulations, or by any order or instructions issued pursuant thereto. CONTRACTOR shall take such action with respect to any subcontract or procurement as the CITY may direct as a means of enforcing such provisions including sanctions for noncompliance; provided, however, that in the event CONTRACTOR becomes involved in, or is threatened with, litigation with a subcontractor or supplier as a result of such direction, CONTRACTOR may request CITY to enter such litigation to protect the interests of CITY.

13. **Entire Agreement.** This document, including all Exhibits, contains the entire agreement between the parties and supersedes whatever oral or written understanding they may have had prior to the execution of this Agreement. No alteration to the terms of this Agreement shall be valid unless approved in writing by CONTRACTOR, and by CITY, in accordance with applicable provisions of the Sacramento City Code.

14. **Severability.** If any portion of this Agreement or the application thereof to any person or circumstance shall be held invalid or unenforceable, the remainder of this Agreement shall not be affected thereby and shall be enforced to the greatest extent permitted by law.

15. **Waiver.** Neither CITY acceptance of, or payment for, any Service or Additional Service performed by CONTRACTOR, nor any waiver by either party of any default, breach or condition precedent, shall be construed as a waiver of any provision of this Agreement, nor as a waiver of any other default, breach or condition precedent or any other right hereunder.

16. **Enforcement of Agreement.** This Agreement shall be governed, construed and enforced in accordance with the laws of the State of California. Venue of any litigation arising out of or connected with this Agreement shall lie exclusively in the state trial court or Federal District Court located in Sacramento County in the State of California, and the parties consent to

jurisdiction over their persons and over the subject matter of any such litigation in such courts, and consent to service of process issued by such courts.

17. **Assignment Prohibited.** The expertise and experience of CONTRACTOR are material considerations for this Agreement. CITY has a strong interest in the qualifications and capability of the persons and entities that will fulfill the obligations imposed on CONTRACTOR under this Agreement. In recognition of this interest, CONTRACTOR shall not assign any right or obligation pursuant to this Agreement without the written consent of the CITY. Any attempted or purported assignment without CITY's written consent shall be void and of no effect.

18. **Binding Effect.** This Agreement shall be binding on the heirs, executors, administrators, successors and assigns of the parties, subject to the provisions of Section 17, above.

19. **Use Tax Requirements.** During the performance of this Agreement, CONTRACTOR, for itself, its assignees and successors in interest, agrees as follows:

    A. Use Tax Direct Payment Permit: For all leases and purchases of materials, equipment, supplies, or other tangible personal property used to perform the Agreement and shipped from outside California, the Contractor and any subcontractors leasing or purchasing such materials, equipment, supplies or other tangible personal property shall obtain a Use Tax Direct Payment Permit from the California State Board of Equalization ("SBE") in accordance with the applicable SBE criteria and requirements.

    B. Sellers Permit: For any construction contract and any construction subcontract in the amount of $5,000,000 or more, Contractor and the subcontractor(s) shall obtain sellers permits from the SBE and shall register the jobsite as the place of business for the purpose of allocating local sales and use tax to the City. Contractor and its subcontractors shall remit the self-accrued use tax to the SBE, and shall provide a copy of each remittance to the City.

    C. The above provisions shall apply in all instances unless prohibited by the funding source for the Agreement.

EXHIBIT E

REQUIREMENTS OF THE NON-DISCRIMINATION IN EMPLOYEE BENEFITS CODE

INTRODUCTION

The Sacramento Non-Discrimination In Employee Benefits Code (the "Ordinance"), codified as Sacramento City Code Chapter 3.54, prohibits City contractors from discriminating in the provision of employee benefits between employees with spouses and employees with domestic partners, and between the spouses and domestic partners of employees.

APPLICATION

The provisions of the Ordinance apply to any contract or agreement (as defined below), between a Contractor and the City of Sacramento, in an amount exceeding $100,000.00. The Ordinance applies to that portion of a contractor's operations that occur: (i) within the City of Sacramento; (ii) on real property outside the City of Sacramento if the property is owned by the City or if the City has a right to occupy the property; or (iii) at any location where a significant amount of work related to a City contract is being performed.

The Ordinance does not apply: to subcontractors or subcontracts of any Contractor or contractors; to transactions entered into pursuant to cooperative purchasing agreements approved by the Sacramento City Council; to legal contracts of other governmental jurisdictions or public agencies without separate competitive bidding by the City; where the requirements of the ordinance will violate or are inconsistent with the terms or conditions of a grant, subvention or agreement with a public agency or the instructions of an authorized representative of any such agency with respect to any such grant, subvention or agreement; to permits for excavation or street construction; or to agreements for the use of City right-of-way where a contracting utility has the power of eminent domain.

DEFINITIONS

As set forth in the Ordinance, the following definitions apply:

"Contract" means an agreement for public works or improvements to be performed, or for goods or services to be purchased or grants to be provided, at the expense of the City or to be paid out of moneys deposited in the treasury or out of the trust money under the control or collected by the City. "Contract" also means a written agreement for the exclusive use ("exclusive use" means the right to use or occupy real property to the exclusion of others, other than the right reserved by the fee owner) or occupancy of real property for a term exceeding 29 days in any calendar year, whether by singular or cumulative instrument, (i) for the operation or use by others of real property owned or controlled by the City for the operation of a business, social, or other establishment or organization, including leases, concessions, franchises and easements, or (ii) for the City's use or occupancy of real property owned by others, including leases, concessions, franchises and easements.

"Contract" shall not include: a revocable at-will use or encroachment permit for the use of or encroachment on City property regardless of the ultimate duration of such permit; excavation, street construction or street use permits; agreements for the use of City right-of-way where a contracting

utility has the power of eminent domain; or agreements governing the use of City property that constitute a public forum for activities that are primarily for the purpose of espousing or advocating causes or ideas and that are generally protected by the First Amendment to the United States Constitution or that are primarily recreational in nature.

"Contractor" means any person or persons, firm, partnership, corporation, company, or combination thereof, that enters into a Contract with the City. "Contractor" does not include a public entity.

"Domestic Partner" means any person who has a currently registered domestic partnership with a governmental entity pursuant to state or local law authorizing the registration.

"Employee Benefits" means bereavement leave; disability, life, and other types of insurance; family medical leave; health benefits; membership or membership discounts; moving expenses; pension and retirement benefits; vacation; travel benefits; and any other benefit given to employees. "Employee benefits" shall not include benefits to the extent that the application of the requirements of this chapter to such benefits may be preempted by federal or state.

CONTRACTOR'S OBLIGATION TO PROVIDE THE CITY WITH DOCUMENTATION AND INFORMATION

Contractor shall provide the City with documentation and information verifying its compliance with the requirements of the Ordinance within ten (10) days of receipt of a request from the City. Contractors shall keep accurate payroll records, showing, for each City Contract, the employee's name, address, Social Security number, work classification, straight time pay rate, overtime pay rate, overtime hours worked, status and exemptions, and benefits for each day and pay period that the employee works on the City Contract. Each request for payroll records shall be accompanied by an affidavit to be completed and returned by the Contractor, as stated, attesting that the information contained in the payroll records is true and correct, and that the Contractor has complied with the requirements of the Ordinance. A violation of the Ordinance or noncompliance with the requirements of the Ordinance shall constitute a breach of contract.

EMPLOYER COMPLIANCE CERTIFICATE AND NOTICE REQUIREMENTS

(a) All contractors seeking a Contract subject to the Ordinance shall submit a completed Declaration of Compliance Form, signed by an authorized representative, with each proposal, bid or application. The Declaration of Compliance shall be made a part of the executed contract, and will be made available for public inspection and copying during regular business hours.

(b) The Contractor shall give each existing employee working directly on a City contract, and (at the time of hire), each new employee, a copy of the notification provided as Attachment "A."

(c) Contractor shall post, in a place visible to all employees, a copy of the notice provided as Attachment "B."

Attachment A

YOUR RIGHTS UNDER THE CITY OF SACRAMENTO'S NON-DISCRIMINATION IN EMPLOYEE BENEFITS CODE

On Aug 9, 2016 (date), your employer (the "Employer") entered into a contract with the City of Sacramento (the "City") for Shasta Park (contract details), and as a condition of that contract, agreed to abide by the requirements of the City's Non-Discrimination In Employee Benefits Code (Sacramento City Code Section 3.54).

The Ordinance does not require the Employer to provide employee benefits. The Ordinance does require that if certain employee benefits are provided by the Employer, that those benefits be provided without discrimination between employees with spouses and employees with domestic partners, and without discrimination between the spouse or domestic partner of employees.

The Ordinance covers any employee working on the specific contract referenced above, but only for the period of time while those employees are actually working on this specific contract.

The included employee benefits are:

- Bereavement leave
- Disability, life and other types of insurance
- Family medical leave
- Health benefits
- Membership or membership discounts
- Moving expenses
- Pension and retirement benefits
- Vacation
- Travel benefits
- Any other benefits given to employees

(Employee Benefits does not include benefits that may be preempted by federal or state law.)

If you feel you have been discriminated or retaliated against by your employer in the terms and conditions of your application for employment, or in your employment, or in the application of these employee benefits, because of your status as an applicant or as an employee protected by the Ordinance, or because you reported a violation of the Ordinance, and after having exhausted all remedies with your employer,

You May . . .

- Submit a written complaint to the City of Sacramento, Contract Services Unit, containing the details of the alleged violation. The address is:

  City of Sacramento
  Procurement Services Division
  915 I Street, Second Floor
  Sacramento, CA 95814

- Bring an action in the appropriate division of the Superior Court of the State of California against the Employer and obtain the following remedies:

  - Reinstatement, injunctive relief, compensatory damages and punitive damages

  - Reasonable attorney's fees and costs

Attachment B

YOUR RIGHTS UNDER THE CITY OF SACRAMENTO'S NON-DISCRIMINATION IN EMPLOYEE BENEFITS CODE

If your employer provides employee benefits, they must be provided to those employees working on a City of Sacramento contract without discriminating between employees with spouses and employees with domestic partners.

The included employee benefits are:

- Bereavement leave
- Disability, life and other types of insurance
- Family medical leave
- Health benefits
- Membership or membership discounts
- Moving expenses
- Pension and retirement benefits
- Vacation
- Travel benefits
- Any other benefits given to employees

If you feel you have been discriminated against by your employer . . .

You May . . .

○ Submit a written complaint to the City of Sacramento, Contract Services Unit, containing the details of the alleged violation. The address is:

City of Sacramento
Procurement Services Division
915 I Street, Second Floor
Sacramento, CA 95814

○ Bring an action in the appropriate division of the Superior Court of the State of California against the employer and obtain reinstatement, injunctive relief, compensatory damages, punitive damages and reasonable attorney's fees and costs.

Discrimination and Retaliation Prohibited.

If you feel you have been discriminated or retaliated against by your employer in the terms and conditions of your application for employment, or in your employment, because of your status as an applicant or as an employee protected by the Ordinance, or because you reported a violation of this Ordinance . . .

You May Also . . .

Submit a written complaint to the City of Sacramento, Contract Services Unit, at the same address, containing the details of the alleged violation.