

CONTRACT DOCUMENTS FOR THE

PAD D STANDBY WELL WATER TREATMENT PLANT EPA Project No. WS-04-2015/16

DRAFT 100% SUBMITTAL



PUBLIC WORKS DEPARTMENT

Engineering Division

1960 Tate Street

East Palo Alto, CA 94303

Phone: (650) 853-3100

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**NOTICE TO BIDDERS, PROPOSAL, CONTRACT, AND
TECHNICAL SPECIFICATIONS FOR THE**

**PAD D STANDBY WELL
WATER TREATMENT PLANT
EPA Project No. WS-04-2015/16**

CITY MANAGER
Jaime Fontes

Prepared by:

[[SIGNATURE]]

NELSON SCHLATER, P.E.
EKI Environment & Water, Inc.

Approved for Construction:

[[SIGNATURE]]

KAMAL FALLAHA
Public Works Director

CERTIFICATION PAGE

The specifications for the project have been prepared under the direction of the following design professions licensed in the State of California.



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City of East Palo Alto

Pad D Standby Well Water Treatment Plant

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**City of East Palo Alto
Public Works Department**

NOTICE IS HEREBY GIVEN that sealed bids will be received by the City of East Palo Alto herein referred to as “City,” at the Office of the City Clerk of the City of East Palo Alto, 2415 University Avenue, East Palo Alto, CA. 94303, until 2:00 o’clock, p.m., on **December 12, 2020**, for furnishing all labor, material, tax, transportation, equipment, and services necessary for: **Pad D Standby Well Water Treatment Plant, EPA Project No. WS-04-2015/16.**

Bids will be opened and tabulated by or on behalf of the City Clerk immediately after receipt of bids at the specified date and time above. Any bids received after the time specified shall be returned unopened.

Deliver bids to: East Palo Alto City Hall – City Clerk’s Office, 2415 University Avenue, East Palo Alto, CA. 94303. If you choose to send your Bid Proposal via an overnight or express service, it must be marked on the outside: **Sealed Bid for Pad D Standby Well Water Treatment Plant, EPA Project No. WS-04-2015/16 – deliver immediately to the City Clerk’s Office, per the bid date specified above.**

This project shall be conducted in accordance with the plans, specifications and other contract documents, all of which may be examined at the Public Works Department, Engineering Division at 1960 Tate Street, East Palo Alto, CA 94303, Phone: (650) 853-3100. A non-mandatory pre-bid conference is scheduled for **November 15, 2020** at 2:00 PM. This non-mandatory pre-bid conference will be the only time the City will open the gates for prospective bidders to access the site. Bidders are required for familiarizing themselves with the project site in accordance with Article 5 – Bidder’s Representations of Section 00200 – Instructions to Bidders. The last day that project questions will be accepted is January 4, 2017.

In accordance with the plans and specifications and other bid documents, the work generally consists of the construction of: a new well production well, submersible vertical turbine well pump;; chemical feed metering and storage; hydro-pneumatic tank; and appurtenant civil, mechanical, structural, electrical, instrumentation and control improvements.

The Project will be financed in whole or in part by the following funding sources: California Department of Water Resources Proposition 84 funds.

Evaluation of the bids will be based on the “Total Bid Price – Sum of Lump Sum Bid Items 1 through 5, plus Additive Bid Item No. 1 for a Lump Sum” listed on the Bid Form in Section 00410 Article 5 of these specifications. If Owner awards the contract for the Work, a Lump Sum contract will be awarded to the responsible Bidder submitting the lowest responsive Bid (See Section 00200 Article 19 - Instruction to Bidders for definitions of responsive and responsible).

Plans and specifications may be obtained for electronic download from the City website, <https://www.cityofepa.org/rfps>. Bidders will be required to register on the site. Hard copies are available for a non-refundable payment of \$100.

All communications relative to the day-to-day administration of this work shall be directed to Jeff Tarantino, (415) 534-7070, email: tarantino@freyerlaureta.com

PUBLISH: _____ and _____

Date _____
City Clerk

SECTION 00200 - INSTRUCTIONS TO BIDDERS

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ARTICLE 1 – DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. *Issuing Office* – The office from which the Bidding Documents are to be issued, specifically the Public Works Department, Engineering Division at 1960 Tate Street, East Palo Alto, CA 94303, Phone: (650) 853-3100.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office in the number and format stated in the notice inviting bids.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer nor Design Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 To demonstrate Bidder's qualifications to perform the Work, Bidder shall submit with its Bid written evidence establishing its qualifications such as financial data, previous experience, and present commitments in the form of a filled-out version of the pre-qualification questionnaire provided as Section 00435 and 00400 of these Contract Documents. Bidders shall have a Class A License and well driller shall have a C57 License.
- 3.02 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.03 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.
- 3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.
- 3.05 Well driller, whether acting as the general contractor or a subcontractor, shall submit a list of at least 5 municipal groundwater supply wells completed in the last 5 years that were at least 300 feet in depth. **The list shall be submitted as a part of the bid proposal.**

ARTICLE 4 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE

- 4.01 *Site and Other Areas*
- A. The Site is identified in the Bidding Documents. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

4.02 Existing Site Conditions

- A. Subsurface and Physical Conditions; Hazardous Environmental Conditions
 - 1. The Supplementary Conditions identify:
 - a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
 - b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
 - c. reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
 - 2. Owner will make copies of reports and drawings referenced above available to any Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
 - 3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.
 - 4. Not used.
- B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
- C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 Other Work at the Site

- A. Reference is made to Article 8 of the Supplementary Conditions for the identification of the general nature of other work of which Owner is aware (if any) that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) and relates to the Work contemplated by these Bidding Documents. If Owner is party to a written contract for such other work, then on request, Owner will provide to each Bidder access to examine such contracts (other than portions thereof related to price and other confidential matters), if any.

ARTICLE 5 – BIDDER’S REPRESENTATIONS

5.01 It is the responsibility of each Bidder before submitting a Bid to:

- A. examine and carefully study the Bidding Documents, and any data and reference items identified in the Bidding Documents;
- B. attend the non-mandatory pre-bid conference, and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study all reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings;
- E. consider the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder’s safety precautions and programs;
- F. agree, based on the information and observations referred to in the preceding paragraph, that at the time of submitting its Bid no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder;
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work; and
- J. agree that the submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 6 – PRE-BID CONFERENCE

6.01 A non-mandatory pre-Bid conference will be held at the time and location stated in the notice inviting bids. Representatives of Owner, Engineer, and Design Engineer will be present to discuss the Project. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer

considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

- 7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing as specified in Section 00111-Notice Inviting Bidders prior to the time set for opening of Bids. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda delivered to all parties recorded as having received the Bidding Documents. Questions received less than the time specified in Section 00111-Notice Inviting Bidders prior to the date for opening of Bids will not be answered. Neither the Engineer or any representative of the Owner is authorized to give oral explanations or interpretations of Contract Documents, and a submission of a bid constitutes agreement by the bidder that it has placed no reliance on any such oral explanation or interpretation. However, the Engineer may, upon inquiry by bidder, orally direct the bidder’s attention to specific provisions of the Contract Documents which cover the subject of the inquiry. Bidders shall not contact the Design Engineer or any specialty design consultants retained by the Owner. Any inquiries shall be typed and emailed to the City of East Palo Alto, attention Jeff Tarantino, email: tarantino@freyerlaureta.com.
- 7.02 Addenda may be issued to clarify, correct, supplement, or change the Bidding Documents.

ARTICLE 8 – BID SECURITY

- 8.01 All bids shall be accompanied by Bid Security, as defined herein, made payable to the City. The Bid Security shall include cash, cashier’s check made payable to the City, certified check made payable to the City, or a Bid Bond executed by an admitted surety insurer. The Bid Security must be enclosed in the same envelope with the bid. The amount of the Bid Security shall be not less than ten percent (10%) of the total amount of the bid. For the purposes of this Section, “the amount of the bid” includes all additive alternates but does not include deductive alternates.
- 8.02 The Attorney-in-Fact (resident agent) who executes the Bid Bond on behalf of the surety company must attach a copy of its Power of Attorney as evidence of its authority. A notary shall acknowledge the power as of the date of execution of the surety bond which it covers.
- 8.03 A Bid Bond will be accepted only if it is made out on either the Bid Bond form enclosed in these documents or on a form which conforms to it. All bonds are to be secured from a surety company acceptable to the City and that meets all of the State of California bonding requirements, as defined in Code of Civil Procedure section 995.120, and is authorized by the State of California, and all documents required by Code of Civil Procedure section 995.660, to the extent required by law.
- 8.04 The Bid security of the apparent Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract Documents, furnished the required contract security, and met the other conditions of the Notice of Award, whereupon the Bid security will be released. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 10 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner’s exclusive remedy if Bidder defaults.

- 8.05 The Bid security of other Bidders that Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Contract or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be released.
- 8.06 Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the Bid opening.
- 8.07 Bidders are hereby notified that in accordance with the provisions of Public Contract Code Section 22300, securities may be substituted for any monies which the Owner may withhold pursuant to the terms of this Contract to ensure performance.

ARTICLE 9 – CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which the Work is to be substantially completed and ready for final payment are set forth in the Agreement.
- 9.02 Time of completion of the work is of the essence of this Contract. The Contractor shall commence work within ten (10) days of the Notice to Proceed, and diligently prosecute the work to completion within the time frames set forth in the Agreement.

ARTICLE 10 – LIQUIDATED DAMAGES

- 10.01 Provisions for liquidated damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 11 – SUBSTITUTE AND “OR-EQUAL” ITEMS

- 11.01 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration during the bidding and Contract award process of possible substitute or “or-equal” items. In cases in which the Contract allows the Contractor to request that Engineer authorize the use of a substitute or “or-equal” item of material or equipment, application for such acceptance may not be made to and will not be considered by Engineer until after the Effective Date of the Contract.
- 11.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

ARTICLE 12 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 12.01 A Bidder shall be prepared to retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of the Work if required by the Bidding Documents (most commonly in the Specifications) to do so. If a prospective Bidder objects to retaining any such Subcontractor, Supplier, or other individual or entity, and the concern is not relieved by an Addendum, then the prospective Bidder should refrain from submitting a Bid.
- 12.02 Subsequent to the submittal of the Bid, Owner may not require the Successful Bidder or Contractor to retain any Subcontractor, Supplier, or other individual or entity against which Contractor has reasonable objection.

- 12.03 Each bidder shall set forth in its Bid the following information in accordance with the provisions of the "Subletting and Subcontracting Fair Practices Act" set forth in Public Contract Code section 4100 et seq.
- A. The name and the location of the place of business of each subcontractor who will perform work or labor or render service to the bidder in or about the construction of the work or improvement, or a subcontractor licensed by the State of California who, under subcontract to the bidder, specifically fabricates and installs a portion of the work or improvement according to the Contract Documents, in any amount in excess of one-half of one percent (0.5%) of the bidder's total bid, or, in the case of bids or offers for the construction of streets or highways, including bridges, in excess of one-half of one percent (0.5%) of the bidder's total bid or ten thousand dollars (\$10,000), whichever is greater.
 - B. The portion of the work which will be done by each such subcontractor. Only one subcontractor shall be listed for each such portion of the work as defined in the bid.
- 12.04 If the bidder fails to specify a subcontractor or lists more than one subcontractor for any portion of the work to be performed under the Contract as required by this Section, the bidder agrees to perform that portion of the work itself.

ARTICLE 13 – PREPARATION OF BID

- 13.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
 - B. Bids shall be submitted only on the forms attached hereto or copies thereof and shall be enclosed in a sealed envelope and marked and addressed as hereinafter directed. The bidder shall state in figures the unit prices or the specific sums and the case may be, for which it proposed to supply the labor, materials, supplies, or machinery, and perform the work required by the plans and specifications.
 - C. The language and form of the bid form must not be changed and no additions shall be made to the items mentioned therein. Unauthorized conditions, limitations, or provisions attached to a bid will render the bid nonconforming and may cause its rejection. If erasures, interlineations, or other changes appear on the form, each erasure, interlineation, or change must be initialed by the person signing the bid. Alternative bids will not be considered unless specifically provided for in the bid.
 - D. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words "No Bid" or "Not Applicable."
- 13.02 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation shall be shown.
- 13.03 A Bid by a limited liability company shall be executed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.
- 13.04 A Bid by an individual shall show the Bidder's name and official address.

- 13.05 A Bid by a joint venture shall be executed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.
- 13.06 All names shall be printed in ink below the signatures.
- 13.07 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.08 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 13.09 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 – BASIS OF BID

- 14.01 Base Bid with Alternates
 - A. Bidders shall submit a Bid on a lump sum basis for the base Bid and include a separate price for each alternate described in the Bidding Documents and as provided for in the Bid Form. The price for each alternate will be the amount added to or deleted from the base Bid if Owner selects the alternate.
 - B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form.
- 14.02 *Not used*
- 14.03 *Allowances*
 - A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 13.02.B of the General Conditions.

ARTICLE 15 – SUBMITTAL OF BID

- 15.01 Deliver bids to:
 - East Palo Alto City Hall – City Clerk's Office
 - 2415 University Avenue, East Palo Alto, CA. 94303
- 15.02 If you choose to send your Bid Proposal via an overnight or express service, it must be marked on the outside: **"Sealed Bid for Pad D Standby Well Water Treatment Plant, EPA Project No. WS-04-2015/16 – deliver immediately to the City Clerk's Office, Bid Date-Time: as specified in Section 00111-Notice Inviting Bids.**
- 15.03 A Bid shall be received no later than the date and time prescribed and at the place indicated in notice inviting bids, and shall be accompanied by the Bid security and other required documents.

- 15.04 Bids received after the date and time prescribed for the opening of bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened.
- 15.05 A complete bid requires submission of a fully completed bid, bid security, and any addenda or clarifications issued during the bidding period acknowledged by the bidder's signature thereon. Failure to so include or acknowledge an addendum or clarification may result in the bid being rejected as non-responsive.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

- 16.01 A Bid may be withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 16.02 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 16.01 and submit a new Bid prior to the date and time for the opening of Bids.
- 16.03 No bid may be withdrawn after the opening of bids without rendering the accompanying Bid Security subject to retention.

ARTICLE 17 – OPENING OF BIDS

- 17.01 Bids will be opened at the time and place indicated in the notice inviting bids and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

- 18.01 All Bids will remain subject to acceptance for the period of time stated in the Bid Form, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to the end of this period.

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.01 Evaluation of Bids will be based on the "Total Bid Price - Sum of Lump Sum Bid Items 1 through 5, plus Additive Bid Item No. 1 for a Lump Sum" listed on the Bid Form in Section 00410 Article 5 of these specifications and as further described herein.
- 19.02 For a period of ninety (90) calendar days after the date of opening:
- A. Owner reserves the right to reject any or all Bids, including without limitation, non-conforming, non-responsive, unbalanced, or conditional Bids,
 - B. Owner will reject the Bid as non-responsive, if Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid.
 - C. Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to be non-responsible.

- D. Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.
- 19.03 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid.
- 19.04 Evaluation of Bids
- A. In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- 19.05 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 19.06 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.
- 19.07 The issuance by the Owner of a notice to the successful bidder of the award of the contract (hereinafter "Notice of Award") shall be deemed the award of the contract.

ARTICLE 20 – BID PROTESTS

- 20.01 Any protest of the proposed Project award must be submitted in writing to the City no later than 5:00 PM on the third business day following the date of the bid opening.
- 20.02 The protest must contain a complete statement of the basis for the protest.
- 20.03 The protest must state the facts and refer to the specific portion of the document or the specific statute that forms the basis for the protest. The protest must include the name, address, and telephone number of the person representing the protesting party.
- 20.04 The party filing the protest must concurrently transmit a copy of the protest to the proposed awardee.
- 20.05 The party filing the protest must have actually submitted a bid for the Project. A subcontractor of a party filing a bid for the Project may not submit a bid protest. A party may not rely on the bid protest submitted by another bidder, but must timely pursue its own protest.
- 20.06 The procedure and time limits set forth in these Instructions to Bidders are mandatory and are the bidders' sole and exclusive remedy in the event of a bid protest. Any bidder's failure to fully comply with these procedures will constitute a waiver of any right to further pursue a bid protest, including filing of a challenge of the award pursuant to the California Public Contract Code, filing of a claim pursuant to the California Government Code, or filing of any other legal proceedings.
- 20.07 The City will review all timely protests prior to award of the Project. The City will not be required to hold an administrative hearing to consider any protests, but may do so at its option. At the time of the City Council's consideration of the Project award, the City Council will also consider the merits of any timely protests. The City Council may either reject the protest and award to the lowest responsive responsible bidder or accept the protest and award the bid to the next lowest responsive responsible bidder. Nothing in this section will be construed as a waiver of the City Council's right to reject all bids.

ARTICLE 21 – BONDS AND INSURANCE

21.01 Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner’s requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the Agreement (executed by Successful Bidder) to Owner, it shall be accompanied by required bonds and insurance documentation.

ARTICLE 22 – SIGNING OF AGREEMENT

22.01 The successful bidder will be notified in writing by the Owner of the award of the Contract within ninety (90) calendar days after opening of bids, unless the time period is extended as provided in the Notice Inviting Bids. Two copies of the Contract will accompany the Owner’s Notice of Award. The successful bidder will be required to execute and return the Contract, together with the Performance and Payment Bonds, and the required policies of insurance together with the required endorsements thereto for the Contractor and the workers compensation certificate, to the Owner within ten (10) work days following receipt of such Notice of Award. Failure to do so shall be just cause for annulment of the award and for forfeiture of the Bid Security. The Owner will promptly determine whether such Contract, Bonds and insurance are as required by the Contract Documents, and upon such determination will forward a fully executed copy of the Contract and a Notice to Proceed with the work to the successful bidder. Signature by both parties constitutes execution of the Contract. In the event of failure of the lowest responsive responsible bidder to sign and return the Contract with acceptable Bonds and insurance as prescribed herein, the Owner may award the Contract to the next lowest responsive responsible bidder, and, in the event that bidder fails to sign and return the Contract with acceptable Bonds and insurance, the Owner may award the Contract to the then next lowest responsive responsible bidder, etc.

ARTICLE 23 – EXECUTION OF PRE-SELECTED EQUIPMENT ASSIGNMENT CONTRACT

23.01 Not Used

ARTICLE 24 – ESCROW OF BID DOCUMENTS

24.01 The Contractor is required to present all documentation used by the Contractor in arriving at the bid upon which the Contract was awarded (“Bid Document”) to the Engineer in accordance with the conditions in Paragraph SC-7. of the Supplemental Conditions.

ARTICLE 25 – PREVAILING WAGES

25.01 Pursuant to section 1770 et seq. of the Labor Code of the State of California, the Director of Industrial Relations has ascertained the general prevailing rate of per diem wages and the rates for overtime and holiday work in the locality in which the work is to be performed for each craft, classification or type of worker needed to execute the contract which will be awarded to the successful bidder. Copies are on file with and available upon request from the Engineer and may also be obtained the website of the Division of Labor Statistics and Research, California Department of Industrial Relations located at <https://www.dir.ca.gov/OPRL/DPreWageDetermination.htm>. The successful bidder shall post a copy thereof at each job site. The requirement to pay these wage rates is further detailed in Part IV, Section E(2) of General Conditions. It shall be mandatory upon the bidder to whom the Contract is awarded, and upon any subcontractor under him to comply with all Labor Code

provisions, which include, but are not limited to the payment of not less than the said specified rates to all workers employed by them in the execution of the Contract, employment of apprentices, hours of labor and debarment of contractors and subcontractors.

- 25.02 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].
- 25.03 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 the Labor Code section 1725.5.
- 25.04 All contractors and subcontractor must furnish electronic certified payroll records directly to Labor Commissioner once monthly. In addition, the contractor and subcontractors must submit the certified payroll records to the District's Labor Compliance Consultant for review.

ARTICLE 26 – FUNDING SOURCES

- 26.01 This project is obtaining funds from three sources in addition to the City utility. The three funding sources are:
- Proposition 84 Grant – Appendix A
- 26.02 Information regarding each of the funding sources is included in the appendix listed above. The information includes: materials and forms related to the particular grant and supplemental conditions and other contract language for each grant that are included as part of this contract. Note that forms marked by an asterisk (*) are required to be submitted with Contractor's bid.

SECTION 00410 - BID FORM

Pad D Standby Well Water Treatment Plant, EPA Project No. WS-04-2015/16

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ARTICLE 1 – BID RECIPIENT

1.01 This Bid is submitted to:
City of East Palo Alto
2415 University Avenue
East Palo Alto, CA 94303

1.02 The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an Agreement with Owner in the form included in the Bidding Documents to perform all Work as specified or indicated in the Bidding Documents for the prices and within the times indicated in this Bid and in accordance with the other terms and conditions of the Bidding Documents.

ARTICLE 2 – BIDDER’S ACKNOWLEDGEMENTS

2.01 Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for 90 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

A. Bidder has examined and carefully studied the Bidding Documents, and any data and reference items identified in the Bidding Documents, and hereby acknowledges receipt of the following Addenda:

<u>Addendum No.</u>	<u>Addendum, Date</u>
_____	_____
_____	_____
_____	_____
_____	_____

B. Bidder has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and satisfied itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

C. Bidder is familiar with and has satisfied itself as to all Laws and Regulations that may affect cost, progress, and performance of the Work.

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.

- E. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and any Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder; and (3) Bidder's safety precautions and programs.
- F. Bidder agrees, based on the information and observations referred to in the preceding paragraph, that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and confirms that the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance and furnishing of the Work.
- J. The submission of this Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article, and that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 4.01.D:
 - 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;
 - 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 - 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 – BASIS OF BID

5.01 Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

Bid Item	Description	Total Bid Price
1	Mobilization and Demobilization (Limit to 5% of Total Bid Price) for Lump sum of (in words) _____ Dollars	\$ _____
2	Worker Protection and Safety/Shoring- Pursuant to CA Labor Code 6707 for a Lump Sum of (in words): _____ Dollars	\$ _____
3	Contractor performed Structural Design for a Lump Sum of (in words): _____ Dollars	\$ _____
4	Well Drilling, Construction, and Testing for a Lump Sum of (in words): _____ Dollars	\$ _____
5	All other work required in the bid scope of work as described in the Contract Documents for a Lump Sum of: (in words): _____ Dollars	\$ _____
ADDITIVE BID ITEM NO. 1	Provide insurance to indemnify the Owner for any damage to the work caused by an Act of God, as allowed for and defined in Section 7105 of the California Public Contract Code for a Lump Sum (in words): _____ Dollars	\$ _____

	Total Bid Price - Sum of Lump Sum Bid Items 1 through 5, plus Additive Bid Item No. 1 for a Lump Sum of (in words): <hr/> <hr/> Dollars	\$ <hr/>
--	---	-----------------

All specified cash allowances are included in the price(s) set forth above, and have been computed in accordance with Paragraph 13.02 of the General Conditions.

Evaluation of Bids shall be in accordance with Section 00200 Article 19.

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 7 – ATTACHMENTS TO THIS BID

7.01 The following documents are submitted with and made a condition of this Bid:

- A. Required Bid security;
- B. List of Proposed Subcontractors;
- C. List of Proposed Suppliers;
- D. List of Project References;
- E. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such license within the time for acceptance of Bids;
- F. Contractor’s License No.: [REDACTED] **[or]** Evidence of Bidder’s ability to obtain a State Contractor’s License and a covenant by Bidder to obtain said license within the time for acceptance of Bids;
- G. Required Bidder Qualification Statement with supporting data;
- H. Contractor’s Certificate Regarding Worker’s Compensation
- I. Noncollusion Affidavit;
- J. Contractor Debarment Certification Form
Forms Associated with Proposition 84 Grant Requirements
- K. Drug-Free Workplace Certification (see Attachment 1 of Appendix A.1)
- L. Nondiscrimination Certification (see Attachment 2 of Appendix A.1)

ARTICLE 8 – DEFINED TERMS

8.01 The terms used in this Bid with initial capital letters have the meanings stated in the Instructions to Bidders, the General Conditions, and the Supplementary Conditions.

ARTICLE 9 – BID SUBMITTAL

BIDDER: *[Indicate correct name of bidding entity]*

By:
[Signature] _____

[Printed name] _____
(If Bidder is a corporation, a limited liability company, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest:
[Signature] _____

[Printed name] _____

Title: _____

Submittal Date: _____

Address for giving notices:

Telephone Number: _____

Fax Number: _____

Contact Name and e-mail address: _____

Bidder's License No.: _____
(where applicable)

SECTION 00430 BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:

SURETY *(Name, and Address of Principal Place of Business)*:

OWNER *(Name and Address)*:

City of East Palo Alto
1960 Tate Street
East Palo Alto, CA 94303

BID

Bid Due Date: December 12, 2020
Description: Pad D Standby Well Water Treatment Plant Project

BOND

Bond Number:
Date:
Penal sum

_____ \$ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER

SURETY

Bidder's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by Owner, or
 - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

SECTION 00435 - CONTRACTOR QUALIFICATION STATEMENT

THE INFORMATION SUPPLIED IN THIS DOCUMENT IS CONFIDENTIAL TO THE EXTENT PERMITTED BY LAWS AND REGULATIONS

The undersigned Bidder represents that it is competent, knowledgeable and has the special skills on the nature, extent and inherent conditions of the work to be performed on this project. Bidder further acknowledges that these inherent conditions existent in the construction of particular facilities may create, during construction, unusual or unsafe conditions hazardous to persons and property. Bidder expressly acknowledges that it is aware of such risks and that it has the skill and experience to foresee and to adopt protective measures to adequately and safely perform the construction work with respect to such hazards.

1. SUBMITTED BY:

Official Name of Firm:

Address:

2. SUBMITTED TO:

3. SUBMITTED FOR:

Owner:

Project Name:

TYPE OF WORK:

4. CONTRACTOR'S CONTACT INFORMATION

Contact Person: _____
Title: _____
Phone: _____
Email: _____

5. AFFILIATED COMPANIES:

Name: _____
Address: _____

6. TYPE OF ORGANIZATION:

SOLE PROPRIETORSHIP

Name of Owner: _____
Doing Business As: _____
Date of Organization: _____

PARTNERSHIP

Date of Organization: _____
Type of Partnership: _____
Name of General Partner(s): _____

CORPORATION

State of Organization: _____
Date of Organization: _____

Executive Officers:

- President:

- Vice President(s):

- Treasurer:

- Secretary:

LIMITED LIABILITY COMPANY

State of Organization:

Date of Organization:

Members:

JOINT VENTURE

State of Organization:

Date of Organization:

Form of Organization:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

Joint Venture Managing Partner

- Name:

- Address:

7. LICENSING

Jurisdiction:

Type of License:

License Number:

Jurisdiction:

Type of License:

License Number:

8. CERTIFICATIONS

CERTIFIED BY:

Disadvantage Business Enterprise:

Minority Business Enterprise:

Woman Owned Enterprise:

Small Business Enterprise:

Other (_____):

9. BONDING INFORMATION

Bonding Company:

Address:

Bonding Agent: _____

Address: _____

Contact Name: _____

Phone: _____

Aggregate Bonding Capacity: _____

Available Bonding Capacity as of date of this submittal: _____

10. FINANCIAL INFORMATION

Financial Institution: _____

Address: _____

Account Manager: _____

Phone: _____

INCLUDE AS AN ATTACHMENT AN AUDITED BALANCE SHEET FOR EACH OF THE
LAST 3 YEARS

11. CONSTRUCTION EXPERIENCE:

Current Experience:

List on **Schedule A** all uncompleted projects currently under contract (If Joint Venture list each participant's projects separately).

Previous Experience:

List on **Schedule B** all projects completed within the last 5 Years (If Joint Venture list each participant's projects separately).

Has firm listed in Section 1 ever failed to complete a construction contract awarded to it?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

Has any Corporate Officer, Partner, Joint Venture participant or Proprietor ever failed to complete a construction contract awarded to them in their name or when acting as a principal of another entity?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

Are there any judgments, claims, disputes or litigation pending or outstanding involving the firm listed in Section 1 or any of its officers (or any of its partners if a partnership or any of the individual entities if a joint venture)?

YES NO

If YES, attach as an Attachment details including Project Owner's contact information.

12. SAFETY PROGRAM:

Name of Contractor's Safety Officer: _____

Include the following as attachments:

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) OSHA No. 500- Log & Summary of Occupational Injuries & Illnesses for the past 5 years.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all OSHA Citations & Notifications of Penalty (monetary or other) received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide as an Attachment Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) list of all safety citations or violations under any state all received within the last 5 years (indicate disposition as applicable) - IF NONE SO STATE.

Provide the following for the firm listed in Section V (and for each proposed Subcontractor furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) the following (attach additional sheets as necessary):

Workers' compensation Experience Modification Rate (EMR) for the last 5 years:

YEAR	_____	EMR	_____
YEAR	_____	EMR	_____
YEAR	_____	EMR	_____

YEAR _____	EMR _____
YEAR _____	EMR _____

Total Recordable Frequency Rate (TRFR) for the last 5 years:

YEAR _____	TRFR _____
YEAR _____	TRFR _____
YEAR _____	TRFR _____
YEAR _____	TRFR _____
YEAR _____	TRFR _____

Total number of man-hours worked for the last 5 Years:

YEAR _____	TOTAL NUMBER OF MAN-HOURS _____	
YEAR _____	TOTAL NUMBER OF MAN-HOURS _____	
YEAR _____	TOTAL NUMBER OF MAN-HOURS _____	
YEAR _____	TOTAL NUMBER OF MAN-HOURS _____	
YEAR _____	TOTAL NUMBER OF MAN-HOURS _____	

Provide Contractor's (and Contractor's proposed Subcontractors and Suppliers furnishing or performing Work having a value in excess of 10 percent of the total amount of the Bid) Days Away From Work, Days of Restricted Work Activity or Job Transfer (DART) incidence rate for the particular industry or type of Work to be performed by Contractor and each of Contractor's proposed Subcontractors and Suppliers) for the last 5 years:

YEAR _____	DART _____
YEAR _____	DART _____
YEAR _____	DART _____
YEAR _____	DART _____
YEAR _____	DART _____

13. EQUIPMENT:

MAJOR EQUIPMENT:

List on **Schedule C** all pieces of major equipment available for use on Owner's Project.

I HEREBY CERTIFY THAT THE INFORMATION SUBMITTED HERewith, INCLUDING ANY ATTACHMENTS, IS TRUE TO THE BEST OF MY KNOWLEDGE AND BELIEF.

NAME OF ORGANIZATION: _____

BY: _____

TITLE: _____

DATED: _____

NOTARY ATTEST:

SUBSCRIBED AND SWORN TO BEFORE ME

THIS _____ DAY OF _____, 20__

NOTARY PUBLIC - STATE OF _____

MY COMMISSION EXPIRES: _____

REQUIRED ATTACHMENTS

- Schedule A (Current Experience).
- Schedule B (Previous Experience).
- Schedule C (Major Equipment).
- Audited balance sheet for each of the last 3 years for firm named in Item 1. (Audited financial reports are preferred. However, reviewed financials prepared in accordance with GAAP and accompanied by a bank reference letter (including, but not limited to, duration of relationship, average annual balances, and verification of available line of credit) are an acceptable alternative to audited financials.
- Evidence of authority for individuals listed in Item 6 to bind organization to an agreement.
- Resumes of officers and key individuals (including Safety Officer) of firm named in Section 1.
- Required safety program submittals listed in Item 12.
- Additional items as pertinent.

**SCHEDULE A
CURRENT EXPERIENCE**

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B
PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE B
PREVIOUS EXPERIENCE (Include ALL Projects Completed within last 5 years)

Project Name	Owner's Contact Person	Design Engineer	Contract Date	Type of Work	Status	Cost of Work
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				
	Name: Address: Telephone:	Name: Company: Telephone:				

SCHEDULE C - LIST OF MAJOR EQUIPMENT AVAILABLE

ITEM	PURCHASE DATE	CONDITION	ACQUIRED VALUE

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SECTION 00445

LIST OF EQUIPMENT/MATERIAL SUPPLIERS FORM

In accordance with Article 19.04 of the Instructions to Bidders, the Bidder shall indicate below which Supplier the Bidder intends to use to furnish, under the Bid, each item of equipment or material listed on this form by writing in one of the named suppliers specified in the Bid Specifications for that equipment or material. If no supplier is named in the Bid Specifications, the Bidder may list any supplier whose product meets all of the requirements and technical criteria specified. A named manufacturer shall be listed for each equipment/material shown. The listing of more than one supplier for any equipment/material to be furnished with the words "and/or" will not be permitted. If the equipment/material is not required for the Bidder's proposed system, "NA" shall be indicated for the equipment/material. Failure to comply with this requirement may render the Bid non-responsive and may result in its rejection.

Equipment/Material	Named Manufacturer (List Only One)
Ammonia Feed System	
Chlorine Tablet System	
Submersible Well Pump / Motor	
Hydropneumatic Tank	
Static in-Line Mixers	
Analyzers	
Emergency Generator	
Pre-Engineered Canopy	

**SECTION 00450 - CONTRACTOR'S CERTIFICATE REGARDING WORKER'S
COMPENSATION**

TO: Jeff Tarantino, Project Manager
1960 Tate Street
East Palo Alto, CA 94303

I am aware of the provisions of Section 3700 of the Labor Code of the State of California which require every employer to be insured against liability for worker's compensation or to undertake self-insurance in accordance with the provisions of that Code, and I will comply with such provisions before commencing the performance of the work of this Contract.

CONTRACTOR:

By: _____

Title: _____

(Business Address)

(Place of Residence)

SECTION 00451 - NONCOLLUSION AFFADAVIT

TO BE EXECUTED BY BIDDER AND SUBMITTED WITH BID

The person signing this bid declares:

I am the _____
of _____, the party making the
foregoing bid.

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. 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 to refrain from bidding. 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. All statements contained in the bid are true. 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, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, to effectuate a collusive or sham bid, and has not paid, and will not pay, any person or entity for such purpose. Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on

_____ (date),
at _____ (city), _____ (state).

SECTION 00452 - TITLE 49, CODE OF FEDERAL REGULATIONS - PART 29
DEBARMENT AND SUSPENSION CERTIFICATION FORM

The bidder, under penalty of perjury, certifies that, except as noted below, he/she or any person associated therewith in the capacity of City, partner, director, officer, manager:

1. Is not currently under suspension, debarment, voluntary exclusion, or determination of ineligibility by any federal agency;

2. Has not been suspended, debarred, voluntarily excluded or determined ineligible by any Federal Agency within the past 3 years;

3. Does not have a proposed debarment pending; and,

4. Has not been indicted, convicted, or had a civil judgment rendered against it by a court of competent jurisdiction in any matter involving fraud or official misconduct within the past 3 years.

If there are any exceptions to this certification, insert the exceptions in the following space:

Exceptions will not necessarily result in denial of award, but will be considered in determining bidder responsibility. For any exception noted above, indicate below to whom it applies, initiating agency, and dates of action.

SECTION 00453

SUBCONTRACTOR DEBARMENT CERTIFICATION FORM

By submitting its bid the bidder certifies in accordance with California Public Contract Code Section 6109 that neither the bidder nor any subcontractor included on the list of proposed subcontractors submitted with the bid is ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7. In accordance with California Public Contract Code Section 6109, contractors and subcontractors who are ineligible to perform work on public works projects pursuant to California Labor Code Sections 1777.1 or 1777.7 may neither bid on, be awarded or perform as a subcontractor on public works projects.

SECTION 00455 - LIST OF SUBCONTRACTORS FORM

In accordance with the requirements of the Subletting and Subcontracting Fair Practices, Act, California Public Contract Code Section 4100 and following, listed below are the name, business location, and the portion (type or trade) of the Project Work to be subcontracted to each subcontractor that will perform a portion of the Project Work (including special fabrication and installation of a portion of the Work) valued in excess of one half of one percent of the total bid price. If the Project Work includes construction of streets or highways, listed below are the name, business location, and the portion (type or trade) of the Project Work to be subcontracted to each subcontractor that will perform a portion of the Project Work (including special fabrication and installation of a portion of the Work) valued in excess of one half of one percent of the total Project bid price, or ten thousand dollars, whichever is greater. Also listed below are the proposed subcontract dollar amount and current California Contractor’s License Number(s) for each proposed subcontractor. Bids that fail to include complete proposed subcontractor information in accordance with this form and Public Contract Code Section 4100 and following may be deemed non-responsive.

In accordance with California Public Contract Code Section 4106, for any portion of the Project Work with a value of more than one half of one percent of the total bid price for which no subcontractor is listed, or for which more than one subcontractor is listed, the bidder certifies by submission of its bid that the bidder is qualified to perform that portion of the Project Work and that the bidder will perform that portion of the Project Work with its own forces. The penalties listed in California Public Contract Code Section 4111 will apply to any substitution of another subcontractor for a subcontractor listed below except as permitted by the City in accordance with Section 4107 and following of the California Public Contract Code.

The Contractor shall perform with his or her own organization, a value of Work amounting to not less than fifty percent (50%) of the contract amount, except that the bid amount for “Specialty Items” so designated in the Contract Documents Provisions may be eliminated from the contract amount and not considered as sub-contracted for the purposes of calculating the value of Work to be performed by the Contractor. For the purposes of determining the value of Work to be performed by the Contractor pursuant to this provision, materials, equipment, incidentals, etc., shall be considered to have been purchased by the contractor or subcontractor that is to install them. Where a portion of an item is subcontracted, the value of Work subcontracted will be based on the estimated cost of such portion of the subcontracted item, as determined from information submitted by the Contractor, subject to approval by the Engineer.

- 1. Subcontractor Name _____
Business Location _____
Trade _____
Subcontract Amount _____

Current Contractor's License No.(s) _____

2. Subcontractor Name _____

Business Location _____

Trade _____

Subcontract Amount _____

Current Contractor's License No.(s) _____

3. Subcontractor Name _____

Business Location _____

Trade _____

Subcontract Amount _____

Current Contractor's License No.(s) _____

4. Subcontractor Name _____

Business Location _____

Trade _____

Subcontract Amount _____

Current Contractor's License No.(s) _____

5. Subcontractor Name _____

Business Location _____

Trade _____

Subcontract Amount _____

Current Contractor's License No.(s) _____

6. Subcontractor Name _____

Business Location _____

Trade _____

Subcontract Amount _____

Current Contractor's License No.(s) _____

7. Subcontractor Name _____

Business Location _____

Trade _____

Subcontract Amount _____

Current Contractor's License No.(s) _____

8. Subcontractor Name _____

Business Location _____

Trade _____

Subcontract Amount _____

Current Contractor's License No.(s) _____

9. Subcontractor Name _____

Business Location _____

Trade _____

Subcontract Amount _____

Current Contractor's License No.(s) _____

10. Subcontractor Name _____

Business Location _____

Trade _____

Subcontract Amount _____

Current Contractor's License No.(s) _____

**SECTION 00520 - AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT**

THIS AGREEMENT is by and between City of East Palo Alto (“Owner”) and
_____ (“Contractor”).

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows: furnishing all work, labor, tools, materials, transportation, equipment, services, and other means of construction necessary to perform and complete in a good and workmanlike manner, those certain improvements entitled, Pad D Standby Well Water Treatment Plant, EPA Project No. WS-04-2015/16.

ARTICLE 2 – THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Pad D Standby Well Water Treatment Plant, EPA Project No. WS-04-2015/16.

ARTICLE 3 – ENGINEER

- 3.01 The Project has been designed by EKI Environment & Water, Inc. (“Design Engineer”)
- 3.02 Jeff Tarantino, P.E., Project Manager with the City of East Palo Alto, will act as “Owner’s Representative”, and will assume all duties and responsibilities, and have the rights and authority assigned to Owner in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.
- 3.03 Nelson Schlater, P.E., Project Manager with EKI Environment & Water, Inc. will act as “Engineer” and will assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 – CONTRACT TIMES

- 4.01 *Time of the Essence*
- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.
- 4.02 *Contract Times: Days*
- A. The Work will be substantially completed within 280 calendar days after the date when the Contract Times commence to run as provided in Paragraph 4.01 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions within 340 calendar days after the date when the Contract Times commence to run.

4.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work is not completed within the times specified in Paragraph 4.02 above, plus any extensions thereof allowed in accordance with the Contract. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty):
1. Substantial Completion: Contractor shall pay Owner \$2,000 for each day that expires after the time (as duly adjusted pursuant to the Contract) specified in Paragraph 4.02.A above for Substantial Completion until the Work is substantially complete.
 2. Completion of Remaining Work: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$2,000 for each day that expires after such time until the Work is completed and ready for final payment.
 3. Liquidated damages for failing to timely attain Substantial Completion and final completion are not additive and will not be imposed concurrently.

ARTICLE 5 – CONTRACT PRICE

- 5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents the amounts that follow, subject to adjustment under the Contract:
- A. For all Work, at the prices stated in Contractor’s Bid, attached hereto as an exhibit.

ARTICLE 6 – PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 15 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor’s Applications for Payment on or about the 10th day of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.
1. Prior to Substantial Completion, progress payments will be made in an amount equal to the approved progress payment less 5% retainage.
 2. Retainage shall be released after the lien period (30-day lien period filing and 15-day processing time) that is initiated Owner has filed the Notice of C

- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the punch list of items to be completed or corrected prior to final payment.

6.03 *Final Payment*

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 15.06 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 15.06.

ARTICLE 7 – INTEREST

- 7.01 All amounts not paid when due shall bear interest at the rate set forth in subdivision (a) of Section 685.010 of the Code of Civil Procedure.

ARTICLE 8 – CONTRACTOR'S REPRESENTATIONS

- 8.01 In order to induce Owner to enter into this Contract, Contractor makes the following representations:
- A. Contractor has examined and carefully studied the Contract Documents, and any data and reference items identified in the Contract Documents.
 - B. Contractor has visited the Site, conducted a thorough, alert visual examination of the Site and adjacent areas, and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or adjacent to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings, and (2) reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, especially with respect to Technical Data in such reports and drawings.
 - E. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (3) Contractor's safety precautions and programs.
 - F. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.

- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.

ARTICLE 9 – CONTRACT DOCUMENTS

9.01 Contents

- A. The Contract Documents consist of the following:
 - 1. This Agreement.
 - 2. Performance bond.
 - 3. Payment bond.
 - 4. Maintenance bond.
 - 5. General Conditions.
 - 6. Supplementary Conditions.
 - 7. Specifications as listed in the table of contents of the Project Manual
 - 8. Project Drawings (not attached but incorporated by reference).
 - 9. Addenda (numbers █ to █, inclusive).
 - 10. Exhibits to this Agreement:
 - a. Exhibit A-1: Contractor's Bid.
 - 11. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
 - 12. Requirements for the following project grant funding sources:
 - a. California Department of Water Resources Proposition 84 (Appendix A)
 - b. Note that the information in the above three appendices is illustrative of the Contractor requirements. The Contractor is responsible for complying with all requirements of the three funding sources listed above.
- B. The documents listed in Paragraph 9.01.A are attached to this Agreement (except as expressly noted otherwise above).

- C. There are no Contract Documents other than those listed above in this Article 9.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the General Conditions.

ARTICLE 10 – MISCELLANEOUS

10.01 *Terms*

- A. Terms used in this Agreement will have the meanings stated in the General Conditions and the Supplementary Conditions.

10.02 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party hereto of any rights under or interests in the Contract will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, money that may become due and money that is due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment, no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.

10.03 *Successors and Assigns*

- A. Owner and Contractor each binds itself, its successors, assigns, and legal representatives to the other party hereto, its successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Contract Documents.

10.04 *Severability*

- A. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.

10.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

10.06 *Prevailing Wages*

- A. The Contractor is aware of the requirements of California Labor Code Sections 1720 et seq. and 1770 et seq., as well as California Code of Regulations, Title 8, section 16000 et seq. ("Prevailing Wage Laws") which require the payment of prevailing wage rates and the performance of other requirements on certain "public works" and "maintenance" projects. Since this Contract involves an applicable "public works" or "maintenance" project, as defined by the Prevailing Wage Laws, and since the total compensation is \$1,000 or more, Contractor agrees to fully comply with such Prevailing Wage Laws. The Contractor shall obtain a copy of the prevailing rates of per diem wages applicable to the work to be performed by subcontractors from the website of the Division of Labor Statistics and Research of the Department of Industrial Relations located at <https://www.dir.ca.gov/OPRL/DPreWageDetermination.htm>. In the alternative, the City shall provide Contractor with a copy of the prevailing rates of per diem wages applicable to the work to be performed by subcontractors. Contractor shall make copies of the prevailing rates of per diem wages for each craft, classification or type of worker needed to perform work on the Project available to interested parties upon request, and shall post copies at the Contractor's principal place of business and at the Project site. Contractor shall defend, indemnify and hold the City, its elected officials, officers, employees and agents free and harmless from any claims, liabilities, costs, penalties or interest arising out of any failure or allege failure to comply with the Prevailing Wage Laws.
- B. The Contractor and each subcontractor shall forfeit as a penalty to the City not more than Two Hundred dollars (\$200) for each calendar day, or portion thereof, for each worker paid less than the stipulated prevailing rate for any work done by him, or by any subcontract under him, in violation of the provisions of the California Labor Code. The difference between such stipulated prevailing wage rate and the amount paid to each worker for each calendar day or portion thereof for which each worker was paid less than the stipulated prevailing wage rate shall be paid to each worker by the Contractor.

10.07 *Other Provisions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are based on EJCDC® C-700, Standard General Conditions for the Construction Contract, published by the Engineers Joint Contract Documents Committee®, and if Owner is the party that has furnished said General Conditions, then Owner has plainly shown all modifications to the standard wording of such published document to the Contractor, through a process such as highlighting or "track changes" (redline/strikeout), or in the Supplementary Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement.

This Agreement will be effective on _____ (which is the Effective Date of the Contract).

OWNER:

CONTRACTOR:

By: _____

By: _____

Title: _____

Title: _____

(If Contractor is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)

Attest: _____

Attest: _____

Title: _____

Title: _____

Address for giving notices:

Address for giving notices:

License No.: _____

(where applicable)

(If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of this Agreement.)

SECTION 00610 - PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

City of East Palo Alto, 2415 University Avenue, East Palo Alto, CA 94303

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description *(name and location):*

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract):*

Amount:

Modifications to this Bond Form: None See Paragraph 16

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal *(seal)*

Surety's Name and Corporate Seal *(seal)*

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.

2. If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except when applicable to participate in a conference as provided in Paragraph 3.

3. If there is no Owner Default under the Construction Contract, the Surety's obligation under this Bond shall arise after:

3.1 The Owner first provides notice to the Contractor and the Surety that the Owner is considering declaring a Contractor Default. Such notice shall indicate whether the Owner is requesting a conference among the Owner, Contractor, and Surety to discuss the Contractor's performance. If the Owner does not request a conference, the Surety may, within five (5) business days after receipt of the Owner's notice, request such a conference. If the Surety timely requests a conference, the Owner shall attend. Unless the Owner agrees otherwise, any conference requested under this Paragraph 3.1 shall be held within ten (10) business days of the Surety's receipt of the Owner's notice. If the Owner, the Contractor, and the Surety agree, the Contractor shall be allowed a reasonable time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default;

3.2 The Owner declares a Contractor Default, terminates the Construction Contract and notifies the Surety; and

3.3 The Owner has agreed to pay the Balance of the Contract Price in accordance with the terms of the Construction Contract to the Surety or to a contractor selected to perform the Construction Contract.

4. Failure on the part of the Owner to comply with the notice requirement in Paragraph 3.1 shall not constitute a failure to comply with a condition precedent to the Surety's obligations, or release the Surety from its obligations, except to the extent the Surety demonstrates actual prejudice.

5. When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:

5.1 Arrange for the Contractor, with the consent of the Owner, to perform and complete the Construction Contract;

5.2 Undertake to perform and complete the Construction Contract itself, through its agents or independent contractors;

5.3 Obtain bids or negotiated proposals from qualified contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and a contractor selected with the Owners concurrence,

to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 7 in excess of the Balance of the Contract Price incurred by the Owner as a result of the Contractor Default; or

5.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:

5.4.1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, make payment to the Owner; or

5.4.2 Deny liability in whole or in part and notify the Owner, citing the reasons for denial.

6. If the Surety does not proceed as provided in Paragraph 5 with reasonable promptness, the Surety shall be deemed to be in default on this Bond seven days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Paragraph 5.4, and the Owner refuses the payment or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.

7. If the Surety elects to act under Paragraph 5.1, 5.2, or 5.3, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. Subject to the commitment by the Owner to pay the Balance of the Contract Price, the Surety is obligated, without duplication for:

7.1 the responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;

7.2 additional legal, design professional, and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 5; and

7.3 liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.

8. If the Surety elects to act under Paragraph 5.1, 5.3, or 5.4, the Surety's liability is limited to the amount of this Bond.

9. The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner or its heirs, executors, administrators, successors, and assigns.

10. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

11. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after a declaration of Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this paragraph are void or prohibited by law, the minimum periods of limitations available to sureties as a defense in the jurisdiction of the suit shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears.

13. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

14. Definitions

14.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made including allowance for the Contractor for any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.

14.2 Construction Contract: The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and changes made to the agreement and the Contract Documents.

14.3 Contractor Default: Failure of the Contractor, which has not been remedied or waived, to perform or otherwise to comply with a material term of the Construction Contract.

14.4 Owner Default: Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.

14.5 Contract Documents: All the documents that comprise the agreement between the Owner and Contractor.

15. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to

be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

SECTION 00615 - PAYMENT BOND

CONTRACTOR (name and address):

SURETY (name and address of principal place of business):

OWNER (name and address): **City of East Palo Alto, 2415 University Avenue, East Palo Alto, CA 94303**

CONSTRUCTION CONTRACT

Effective Date of the Agreement:

Amount:

Description (name and location):

BOND

Bond Number:

Date (not earlier than the Effective Date of the Agreement of the Construction Contract):

Amount:

Modifications to this Bond Form: None See Paragraph 18

Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

SURETY

_____ (seal)

Contractor's Name and Corporate Seal

_____ (seal)

Surety's Name and Corporate Seal

By: _____

Signature

By: _____

Signature (attach power of attorney)

Print Name

Print Name

Title

Title

Attest: _____

Signature

Attest: _____

Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

1. The Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the Owner to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference, subject to the following terms.
2. If the Contractor promptly makes payment of all sums due to Claimants, and defends, indemnifies, and holds harmless the Owner from claims, demands, liens, or suits by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, then the Surety and the Contractor shall have no obligation under this Bond.
3. If there is no Owner Default under the Construction Contract, the Surety's obligation to the Owner under this Bond shall arise after the Owner has promptly notified the Contractor and the Surety (at the address described in Paragraph 13) of claims, demands, liens, or suits against the Owner or the Owner's property by any person or entity seeking payment for labor, materials, or equipment furnished for use in the performance of the Construction Contract, and tendered defense of such claims, demands, liens, or suits to the Contractor and the Surety.
4. When the Owner has satisfied the conditions in Paragraph 3, the Surety shall promptly and at the Surety's expense defend, indemnify, and hold harmless the Owner against a duly tendered claim, demand, lien, or suit.
5. The Surety's obligations to a Claimant under this Bond shall arise after the following:
 - 5.1 Claimants who do not have a direct contract with the Contractor,
 - 5.1.1 have furnished a written notice of non-payment to the Contractor, stating with substantial accuracy the amount claimed and the name of the party to whom the materials were, or equipment was, furnished or supplied or for whom the labor was done or performed, within ninety (90) days after having last performed labor or last furnished materials or equipment included in the Claim; and
 - 5.1.2 have sent a Claim to the Surety (at the address described in Paragraph 13).
 - 5.2 Claimants who are employed by or have a direct contract with the Contractor have sent a Claim to the Surety (at the address described in Paragraph 13).
6. If a notice of non-payment required by Paragraph 5.1.1 is given by the Owner to the Contractor, that is sufficient to satisfy a Claimant's obligation to furnish a written notice of non-payment under Paragraph 5.1.1.
7. When a Claimant has satisfied the conditions of Paragraph 5.1 or 5.2, whichever is applicable, the Surety shall promptly and at the Surety's expense take the following actions:
 - 7.1 Send an answer to the Claimant, with a copy to the Owner, within sixty (60) days after receipt of the Claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
 - 7.2 Pay or arrange for payment of any undisputed amounts.
 - 7.3 The Surety's failure to discharge its obligations under Paragraph 7.1 or 7.2 shall not be deemed to constitute a waiver of defenses the Surety or Contractor may have or acquire as to a Claim, except as to undisputed amounts for which the Surety and Claimant have reached agreement. If, however, the Surety fails to discharge its obligations under Paragraph 7.1 or 7.2, the Surety shall indemnify the Claimant for the reasonable attorney's fees the Claimant incurs thereafter to recover any sums found to be due and owing to the Claimant.
8. The Surety's total obligation shall not exceed the amount of this Bond, plus the amount of reasonable attorney's fees provided under Paragraph 7.3, and the amount of this Bond shall be credited for any payments made in good faith by the Surety.
9. Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any construction performance bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and Surety under this Bond, subject to the Owner's priority to use the funds for the completion of the work.
10. The Surety shall not be liable to the Owner, Claimants, or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for the payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to or give notice on behalf of Claimants, or otherwise have any obligations to Claimants under this Bond.
11. The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

12. No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the state in which the project that is the subject of the Construction Contract is located or after the expiration of one year from the date (1) on which the Claimant sent a Claim to the Surety pursuant to Paragraph 5.1.2 or 5.2, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall be sufficient compliance as of the date received.
14. When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
15. Upon requests by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor and Owner shall promptly furnish a copy of this Bond or shall permit a copy to be made.
16. **Definitions**
 - 16.1 **Claim:** A written statement by the Claimant including at a minimum:
 1. The name of the Claimant;
 2. The name of the person for whom the labor was done, or materials or equipment furnished;
 3. A copy of the agreement or purchase order pursuant to which labor, materials, or equipment was furnished for use in the performance of the Construction Contract;
 4. A brief description of the labor, materials, or equipment furnished;
 5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
 6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
 7. The total amount of previous payments received by the Claimant; and
 - 16.2 **Claimant:** An individual or entity having a direct contract with the Contractor or with a subcontractor of the Contractor to furnish labor, materials, or equipment for use in the performance of the Construction Contract. The term Claimant also includes any individual or entity that has rightfully asserted a claim under an applicable mechanic's lien or similar statute against the real property upon which the Project is located. The intent of this Bond shall be to include without limitation in the terms of "labor, materials, or equipment" that part of the water, gas, power, light, heat, oil, gasoline, telephone service, or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials, or equipment were furnished.
 - 16.3 **Construction Contract:** The agreement between the Owner and Contractor identified on the cover page, including all Contract Documents and all changes made to the agreement and the Contract Documents.
 - 16.4 **Owner Default:** Failure of the Owner, which has not been remedied or waived, to pay the Contractor as required under the Construction Contract or to perform and complete or comply with the other material terms of the Construction Contract.
 - 16.5 **Contract Documents:** All the documents that comprise the agreement between the Owner and Contractor.
8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.
18. Modifications to this Bond are as follows:

This document has important legal consequences; consultation with an attorney is encouraged with respect to its use or modification. This document should be adapted to the particular circumstances of the contemplated Project and the controlling Laws and Regulations.

SECTION 00700 - STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by



Issued and Published Jointly by



These General Conditions have been prepared for use with the Agreement Between Owner and Contractor for Construction Contract (EJCDC® C-520, Stipulated Sum (Lump Sum), or C-525, Cost-Plus, 2013 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other.

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*—(a) A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein: seeking an adjustment of Contract Price or Contract Times, or both; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; contesting Engineer's decision regarding a Change Proposal; seeking resolution of a contractual issue that Engineer has declined to address; or seeking other relief with respect to the terms of the Contract; or (b) a demand or assertion by Contractor directly to Owner, duly submitted in compliance with the procedural requirements set forth herein, contesting Engineer's decision

regarding a Change Proposal; or seeking resolution of a contractual issue that Engineer has declined to address. A demand for money or services by a third party is not a Claim.

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.

23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor’s plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or “RPR” includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and

submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the

result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

48. *Work Change Directive*—A written directive to Contractor issued on or after the Effective Date of the Contract, signed by Owner and recommended by Engineer, ordering an addition, deletion, or revision in the Work.

1.02 Terminology

- A. The words and terms discussed in the following paragraphs are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives:*
1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Article 10 or any other provision of the Contract Documents.
- C. *Day:*
1. The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective:*
1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 15.03 or 15.04).
- E. *Furnish, Install, Perform, Provide:*
1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. *Bonds*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract), the certificates and other evidence of insurance required to be provided by Contractor in accordance with Article 6.
- C. *Evidence of Owner’s Insurance*: After receipt of the executed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each named insured and additional insured (as identified in the Supplementary Conditions or otherwise), the certificates and other evidence of insurance required to be provided by Owner under Article 6.

2.02 *Copies of Documents*

- A. Owner shall furnish to Contractor four printed copies of the Contract (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF). Additional printed copies will be furnished upon request at the cost of reproduction.
- B. Owner shall maintain and safeguard at least one original printed record version of the Contract, including Drawings and Specifications signed and sealed by Engineer and other design professionals. Owner shall make such original printed record version of the Contract available to Contractor for review. Owner may delegate the responsibilities under this provision to Engineer.

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
2. a preliminary Schedule of Submittals; and
3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.03.A, procedures for handling Shop Drawings, Samples, and other submittals, processing Applications for Payment, electronic or digital transmittals, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit and receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.05 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference, attended by Contractor, Engineer, and others as appropriate, will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.03.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
 3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to the component parts of the Work.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.

- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or computer hardware differing from those used in the drafting or transmittal of the items, or from those established in applicable transmittal protocols.

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

- A. Standards Specifications, Codes, Laws and Regulations
 - 1. Reference in the Contract Documents to standard specifications, manuals, reference standards, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard specification, manual, reference standard, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Contract if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.
 - 2. No provision of any such standard specification, manual, reference standard, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the part of the Contract Documents prepared by or for Engineer. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the part of the Contract Documents prepared by or for Engineer.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

1. *Contractor's Verification of Figures and Field Measurements:* Before undertaking each part of the Work, Contractor shall carefully study the Contract Documents, and check and verify pertinent figures and dimensions therein, particularly with respect to applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy that Contractor discovers, or has actual knowledge of, and shall not proceed with any Work affected thereby until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
2. *Contractor's Review of Contract Documents:* If, before or during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) actual field conditions, (c) any standard specification, manual, reference standard, or code, or (d) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 7.15) until the conflict, error, ambiguity, or discrepancy is resolved, by a clarification or interpretation by Engineer, or by an amendment or supplement to the Contract Documents issued pursuant to Paragraph 11.01.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the part of the Contract Documents prepared by or for Engineer shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between such provisions of the Contract Documents and:
 - a. the provisions of any standard specification, manual, reference standard, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference as a Contract Document); or
 - b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract

Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.

- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

- A. Contractor and its Subcontractors and Suppliers shall not:
 - 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions, or reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer; or
 - 2. have or acquire any title or ownership rights in any other Contract Documents, reuse any such Contract Documents for any purpose without Owner's express written consent, or violate any copyrights pertaining to such Contract Documents.
- B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Contract or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Contract. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Contract, whichever date is earlier.

4.02 *Starting the Work*

- A. Contractor shall start to perform the Work on the date when the Contract Times commence to run. No Work shall be done at the Site prior to such date.

4.03 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall be responsible for laying out the Work, shall protect and preserve the established reference points and property monuments, and shall make no changes or relocations without the prior written approval of Owner. Contractor shall report to Engineer whenever any reference point or property monument is lost or destroyed or requires relocation because of necessary changes in grades or locations, and shall be

responsible for the accurate replacement or relocation of such reference points or property monuments by professionally qualified personnel.

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.
 - 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 - 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 - 2. abnormal weather conditions;
 - 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 - 4. acts of war or terrorism.
- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated

with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.

- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.
- G. Contractor must submit any Change Proposal seeking an adjustment in Contract Price or Contract Times under this paragraph within 30 days of the commencement of the delaying, disrupting, or interfering event.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

- A. *Limitation on Use of Site and Other Areas:*
 - 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
 - 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with

such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part by, or based upon, Contractor's performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible.

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 - 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

- A. *Notice by Contractor:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed at the Site either:
1. is of such a nature as to establish that any Technical Data on which Contractor is entitled to rely as provided in Paragraph 5.03 is materially inaccurate; or
 2. is of such a nature as to require a change in the Drawings or Specifications; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except with respect to an emergency) until receipt of a written statement permitting Contractor to do so.

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

- a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
 3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and

- d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 7.15), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer.
 - C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
 - D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
 - E. *Possible Price and Times Adjustments:*
 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.

3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings*: The Supplementary Conditions identify:
 1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 2. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized*: Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take

corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the

Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.

- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is maintaining the policies, coverages, and endorsements required by the Contract. Upon request by Owner or any other insured, Contractor shall also furnish other evidence of such required insurance, including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 Contractor's Insurance

- A. *Workers' Compensation*: Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).
 4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered*: Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 2. claims for damages insured by reasonably available personal injury liability coverage.
 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content*: Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.

8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability*: Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability*: Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance*: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor's operations and completed operations. This insurance shall be maintained for no less than three years after final completion.
- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
1. include at least the specific coverages provided in this Article.
 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.

4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

- A. *Builder's Risk*: Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available

under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.

3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).
 5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will

provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.

- E. *Additional Insurance*: If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property*: If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of

recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.

- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of insurance required by Paragraph 6.05 will be adjusted and settled with the named insured that purchased the policy. Such named insured shall act as fiduciary for the other insureds, and give notice to such other insureds that adjustment and settlement of a claim is in progress. Any other insured may state its position regarding a claim for insured loss in writing within 15 days after notice of such claim.
- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

- A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.
- C. All materials and equipment shall be stored, applied, installed, connected, erected, protected, used, cleaned, and conditioned in accordance with instructions of the applicable Supplier, except as otherwise may be provided in the Contract Documents.

7.04 *"Or Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;

- 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
- b. Contractor certifies that, if approved and incorporated into the Work:
- 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense*: Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination*: Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.
- D. *Effect of Engineer's Determination*: Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request*: If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer considered the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 *Substitutes*

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

- a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and
 - 2) available engineering, sales, maintenance, repair, and replacement services.
 - d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.

- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.
- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.

- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.
- O. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
 - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 Patent Fees and Royalties

- A. Contractor shall pay all license fees and royalties and assume all costs incident to the use in the performance of the Work or the incorporation in the Work of any invention, design, process, product, or device which is the subject of patent rights or copyrights held by others. If a particular invention, design, process, product, or device is specified in the Contract Documents for use in the performance of the Work and if, to the actual knowledge of Owner or Engineer, its use is subject to patent rights or copyrights calling for the payment of any license fee or royalty to others, the existence of such rights shall be disclosed by Owner in the Contract Documents.
- B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

- C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

7.08 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of the submission of Contractor's Bid (or when Contractor became bound under a negotiated contract). Owner shall pay all charges of utility owners for connections for providing permanent service to the Work

7.09 *Taxes*

- A. Contractor shall pay all sales, consumer, use, and other similar taxes required to be paid by Contractor in accordance with the Laws and Regulations of the place of the Project which are applicable during the performance of the Work.

7.10 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work or takes any other action knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all resulting costs and losses, and shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work or other action. It shall not be Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Owner or Contractor may give notice to the other party of any changes after the submission of Contractor's Bid (or after the date when Contractor became bound under a negotiated contract) in Laws or Regulations having an effect on the cost or time of performance of the Work, including but not limited to changes in Laws or Regulations having an effect on procuring permits and on sales, use, value-added, consumption, and other similar taxes. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times resulting from such changes, then within 30 days of such notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

7.11 *Record Documents*

- A. Contractor shall maintain in a safe place at the Site one printed record copy of all Drawings, Specifications, Addenda, Change Orders, Work Change Directives, Field Orders, written interpretations and clarifications, and approved Shop Drawings. Contractor shall keep such record documents in good order and annotate them to show changes made during construction. These record documents, together with all approved Samples, will be available to Engineer for reference. Upon completion of the Work, Contractor shall deliver these record documents to Engineer.

7.12 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
 - 1. all persons on the Site or who may be affected by the Work;
 - 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 - 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of

Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

- F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
- G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

- A. Contractor shall designate a qualified and experienced safety representative at the Site whose duties and responsibilities shall be the prevention of accidents and the maintaining and supervising of safety precautions and programs.

7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of material safety data sheets or other hazard communication information required to be made available to or exchanged between or among employers at the Site in accordance with Laws or Regulations.

7.15 *Emergencies*

- A. In emergencies affecting the safety or protection of persons or the Work or property at the Site or adjacent thereto, Contractor is obligated to act to prevent threatened damage, injury, or loss. Contractor shall give Engineer prompt written notice if Contractor believes that any significant changes in the Work or variations from the Contract Documents have been caused thereby or are required as a result thereof. If Engineer determines that a change in the Contract Documents is required because of the action taken by Contractor in response to such an emergency, a Work Change Directive or Change Order will be issued.

7.16 *Shop Drawings, Samples, and Other Submittals*

- A. *Shop Drawing and Sample Submittal Requirements:*
 - 1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
 3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.
- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals. Each submittal will be identified as Engineer may require.
1. *Shop Drawings:*
 - a. Contractor shall submit the number of copies required in the Specifications.
 - b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 7.16.D.
 2. *Samples:*
 - a. Contractor shall submit the number of Samples required in the Specifications.
 - b. Contractor shall clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 7.16.D.
 3. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Other Submittals:* Contractor shall submit other submittals to Engineer in accordance with the accepted Schedule of Submittals, and pursuant to the applicable terms of the Specifications.
- D. *Engineer's Review:*
1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
 2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.

3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
 4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
 5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
 6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
 7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
 8. Contractor shall perform the Work in compliance with the requirements and commitments set forth in approved Shop Drawings and Samples, subject to the provisions of Paragraph 7.16.D.4.
- E. *Resubmittal Procedures:*
1. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
 2. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
 3. If Contractor requests a change of a previously approved submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.

- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 - 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 - 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 - 1. observations by Engineer;
 - 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 - 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 - 4. use or occupancy of the Work or any part thereof by Owner;
 - 5. any review and approval of a Shop Drawing or Sample submittal;
 - 6. the issuance of a notice of acceptability by Engineer;
 - 7. any inspection, test, or approval by others; or
 - 8. any correction of defective Work by Owner.
- D. If the Contract requires the Contractor to accept the assignment of a contract entered into by Owner, then the specific warranties, guarantees, and correction obligations contained in the assigned contract shall govern with respect to Contractor's performance obligations to Owner for the Work described in the assigned contract.

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for

Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.

- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work at or adjacent to the Site, to perform other work at or adjacent to the Site with Owner's employees, or to arrange to have utility owners perform work at or adjacent to the Site, the following will be set forth in the Supplementary Conditions or provided to Contractor prior to the start of any such other work:
 - 1. the identity of the individual or entity that will have authority and responsibility for coordination of the activities among the various contractors;
 - 2. an itemization of the specific matters to be covered by such authority and responsibility; and
 - 3. the extent of such authority and responsibilities.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

8.03 *Legal Relationships*

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account

information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.
- D. If Contractor damages, delays, disrupts, or interferes with the work of any other contractor, or any utility owner performing other work at or adjacent to the Site, through Contractor's failure to take reasonable and customary measures to avoid such impacts, or if any claim arising out of Contractor's actions, inactions, or negligence in performance of the Work at or adjacent to the Site is made by any such other contractor or utility owner against Contractor, Owner, or Engineer, then Contractor shall (1) promptly attempt to settle the claim as to all parties through negotiations with such other contractor or utility owner, or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law, and (2) indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claims, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such damage, delay, disruption, or interference.

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

- A. Except as otherwise provided in these General Conditions, Owner shall issue all communications to Contractor through Engineer.

9.02 *Replacement of Engineer*

- A. Owner may at its discretion appoint an engineer to replace Engineer, provided Contractor makes no reasonable objection to the replacement engineer. The replacement engineer's status under the Contract Documents shall be that of the former Engineer.

- 9.03 *Furnish Data*
- A. Owner shall promptly furnish the data required of Owner under the Contract Documents.
- 9.04 *Pay When Due*
- A. Owner shall make payments to Contractor when they are due as provided in the Agreement.
- 9.05 *Lands and Easements; Reports, Tests, and Drawings*
- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.
- 9.06 *Insurance*
- A. Owner's responsibilities, if any, with respect to purchasing and maintaining liability and property insurance are set forth in Article 6.
- 9.07 *Change Orders*
- A. Owner's responsibilities with respect to Change Orders are set forth in Article 11.
- 9.08 *Inspections, Tests, and Approvals*
- A. Owner's responsibility with respect to certain inspections, tests, and approvals is set forth in Paragraph 14.02.B.
- 9.09 *Limitations on Owner's Responsibilities*
- A. The Owner shall not supervise, direct, or have control or authority over, nor be responsible for, Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Owner will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- 9.10 *Undisclosed Hazardous Environmental Condition*
- A. Owner's responsibility in respect to an undisclosed Hazardous Environmental Condition is set forth in Paragraph 5.06.
- 9.11 *Evidence of Financial Arrangements*
- A. Upon request of Contractor, Owner shall furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents (including obligations under proposed changes in the Work).
- 9.12 *Safety Programs*
- A. While at the Site, Owner's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Owner has been informed.

- B. Owner shall furnish copies of any applicable Owner safety programs to Contractor.

ARTICLE 10 – ENGINEER’S STATUS DURING CONSTRUCTION

10.01 *Owner’s Representative*

- A. Engineer will be Owner’s representative during the construction period. The duties and responsibilities and the limitations of authority of Engineer as Owner’s representative during construction are set forth in the Contract.

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor’s executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer’s efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer’s visits and observations are subject to all the limitations on Engineer’s authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during or as a result of Engineer’s visits or observations of Contractor’s Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor’s means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

10.03 *Project Representative*

- A. If Owner and Engineer have agreed that Engineer will furnish a Resident Project Representative to represent Engineer at the Site and assist Engineer in observing the progress and quality of the Work, then the authority and responsibilities of any such Resident Project Representative will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 10.08. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer’s consultant, agent, or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

10.04 *Rejecting Defective Work*

- A. Engineer has the authority to reject Work in accordance with Article 14.

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer’s authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.

- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor as set forth in Paragraph 13.03.

10.07 *Decisions on Requirements of Contract Documents and Acceptability of Work*

- A. Engineer will render decisions regarding the requirements of the Contract Documents, and judge the acceptability of the Work, pursuant to the specific procedures set forth herein for initial interpretations, Change Proposals, and acceptance of the Work. In rendering such decisions and judgments, Engineer will not show partiality to Owner or Contractor, and will not be liable to Owner, Contractor, or others in connection with any proceedings, interpretations, decisions, or judgments conducted or rendered in good faith.

10.08 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 10 or under any other provision of the Contract, nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer, shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives will comply with the specific applicable requirements of Owner's and Contractor's safety programs (if any) of which Engineer has been informed.

ARTICLE 11 – AMENDING THE CONTRACT DOCUMENTS; CHANGES IN THE WORK

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.

1. *Change Orders:*

- a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
- b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.

- ##### 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 30 days after the completion of the Work set out in the Work Change Directive. Owner must submit any Claim seeking an adjustment of the Contract Price or the Contract Times, or both, no later than 60 days after issuance of the Work Change Directive.

- ##### 3. *Field Orders:* Engineer may authorize minor changes in the Work if the changes do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Such changes will be accomplished by a Field Order and will be binding on Owner and also on Contractor, which shall perform the Work involved promptly. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

11.02 *Owner-Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work. Such changes shall be supported by Engineer's recommendation, to the extent the change

involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters. Such changes may be accomplished by a Change Order, if Owner and Contractor have agreed as to the effect, if any, of the changes on Contract Times or Contract Price; or by a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved; or, in the case of a deletion in the Work, promptly cease construction activities with respect to such deleted Work. Added or revised Work shall be performed under the applicable conditions of the Contract Documents. Nothing in this paragraph shall obligate Contractor to undertake work that Contractor reasonably concludes cannot be performed in a manner consistent with Contractor's safety obligations under the Contract Documents or Laws and Regulations.

11.03 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents, as amended, modified, or supplemented, except in the case of an emergency as provided in Paragraph 7.15 or in the case of uncovering Work as provided in Paragraph 14.05.

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 - 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 - 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 - 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on the basis of the Cost of the Work (determined as provided in Paragraph 13.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 11.04.C).
- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
 - 1. a mutually acceptable fixed fee; or
 - 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and

11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

- d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
- e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
- f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

- A. Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract. The Change Proposal shall specify any proposed change in Contract Times or Contract Price, or both, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents.
 - 1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 - 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole,

approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.

3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of this Paragraph 11.07, it shall be deemed to be of full force and effect, as if fully executed.

11.08 *Notification to Surety*

- A. If the provisions of any bond require notice to be given to a surety of any change affecting the general scope of the Work or the provisions of the Contract Documents (including, but not limited to, Contract Price or Contract Times), the giving of any such notice will be Contractor's responsibility. The amount of each applicable bond will be adjusted to reflect the effect of any such change.

ARTICLE 12 – CLAIMS

12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
1. Appeals by Owner or Contractor of Engineer’s decisions regarding Change Proposals;
 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor’s knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim submittal and decision process shall resume as of the date of the conclusion of the mediation, as determined by the mediator.
 3. Owner and Contractor shall each pay one-half of the mediator’s fees and costs.
- E. *Partial Approval:* If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim:* If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction,

the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.

- G. *Final and Binding Results:* If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

ARTICLE 13 – COST OF THE WORK; ALLOWANCES; UNIT PRICE WORK

13.01 *Cost of the Work*

- A. *Purposes for Determination of Cost of the Work:* The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included:* Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.
 2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
 - g. The cost of utilities, fuel, and sanitary facilities at the Site.
 - h. Minor expenses such as communication service at the Site, express and courier services, and similar petty cash items in connection with the Work.

- i. The costs of premiums for all bonds and insurance that Contractor is required by the Contract Documents to purchase and maintain.
- C. *Costs Excluded:* The term Cost of the Work shall not include any of the following items:
1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, timekeepers, clerks, and other personnel employed by Contractor, whether at the Site or in Contractor's principal or branch office for general administration of the Work and not specifically included in the agreed upon schedule of job classifications referred to in Paragraph 13.01.B.1 or specifically covered by Paragraph 13.01.B.4. The payroll costs and other compensation excluded here are to be considered administrative costs covered by the Contractor's fee.
 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.
- D. *Contractor's Fee:* When the Work as a whole is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 11.04.C.
- E. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

13.02 Allowances

- A. It is understood that Contractor has included in the Contract Price all allowances so named in the Contract Documents and shall cause the Work so covered to be performed for such sums and by such persons or entities as may be acceptable to Owner and Engineer.
- B. *Cash Allowances:* Contractor agrees that:
1. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
 2. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

- C. *Contingency Allowance*: Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.
- D. Prior to final payment, an appropriate Change Order will be issued as recommended by Engineer to reflect actual amounts due Contractor on account of Work covered by allowances, and the Contract Price shall be correspondingly adjusted.

13.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 14 – TESTS AND INSPECTIONS; CORRECTION, REMOVAL OR ACCEPTANCE OF DEFECTIVE WORK

14.01 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and authorities having jurisdiction will have access to the Site and the Work at reasonable times for their observation, inspection, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's safety procedures and programs so that they may comply therewith as applicable.

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

Such inspections and tests shall be performed by independent inspectors, testing laboratories, or other qualified individuals or entities acceptable to Owner and Engineer.

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to cover the same and Engineer had not acted with reasonable promptness in response to such notice.

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.

- C. *Notice of Defects*: Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement*: Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties*: When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages*: In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so (subject, if such acceptance occurs prior to final payment, to Engineer's confirmation that such acceptance is in general accord with the design intent and applicable engineering principles, and will not endanger public safety). Contractor shall pay all claims, costs, losses, and damages attributable to Owner's evaluation of and determination to accept such defective Work (such costs to be approved by Engineer as to reasonableness), and for the diminished value of the Work to the extent not otherwise paid by Contractor. If any such acceptance occurs prior to final payment, the necessary revisions in the Contract Documents with respect to the Work shall be incorporated in a Change Order. If the parties are unable to agree as to the decrease in the Contract Price, reflecting the diminished value of Work so accepted, then Owner may impose a reasonable set-off against payments due under Article 15. If the acceptance of defective Work occurs after final payment, Contractor shall pay an appropriate amount to Owner.

14.05 *Uncovering Work*

- A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.
- B. If any Work is covered contrary to the written request of Engineer, then Contractor shall, if requested by Engineer, uncover such Work for Engineer's observation, and then replace the covering, all at Contractor's expense.
- C. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, then Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, and provide all necessary labor, material, and equipment.

1. If it is found that the uncovered Work is defective, Contractor shall be responsible for all claims, costs, losses, and damages arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and pending Contractor's full discharge of this responsibility the Owner shall be entitled to impose a reasonable set-off against payments due under Article 15.
2. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, then Contractor may submit a Change Proposal within 30 days of the determination that the Work is not defective.

14.06 *Owner May Stop the Work*

- A. If the Work is defective, or Contractor fails to supply sufficient skilled workers or suitable materials or equipment, or fails to perform the Work in such a way that the completed Work will conform to the Contract Documents, then Owner may order Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, this right of Owner to stop the Work shall not give rise to any duty on the part of Owner to exercise this right for the benefit of Contractor, any Subcontractor, any Supplier, any other individual or entity, or any surety for, or employee or agent of any of them.

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 14.07.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

15.01 *Progress Payments*

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
 2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for

Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and

- c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
 4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
 5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
 6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or
 - e. Engineer has actual knowledge of the occurrence of any of the events that would constitute a default by Contractor and therefore justify termination for cause under the Contract Documents.

D. *Payment Becomes Due:*

1. Ten days after presentation of the Application for Payment to Owner with Engineer's recommendation, the amount recommended (subject to any Owner set-offs) will become due, and when due will be paid by Owner to Contractor.

E. *Reductions in Payment by Owner:*

1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, if Contractor remedies the reasons for such action. The reduction

imposed shall be binding on Contractor unless it duly submits a Change Proposal contesting the reduction.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 15.01.C.1 and subject to interest as provided in the Agreement.

15.02 *Contractor's Warranty of Title*

- A. Contractor warrants and guarantees that title to all Work, materials, and equipment furnished under the Contract will pass to Owner free and clear of (1) all Liens and other title defects, and (2) all patent, licensing, copyright, or royalty obligations, no later than seven days after the time of payment by Owner.

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.
- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor

may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.

- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

- A. Upon written notice from Contractor that the entire Work or an agreed portion thereof is complete, Engineer will promptly make a final inspection with Owner and Contractor and will notify Contractor in writing of all particulars in which this inspection reveals that the Work, or agreed portion thereof, is incomplete or defective. Contractor shall immediately take such measures as are necessary to complete such Work or remedy such deficiencies.

15.06 *Final Payment*

- A. *Application for Payment:*
 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of

inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.

D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer

(less any further sum Owner is entitled to set off against Engineer's recommendation, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with

respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

- E. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by written notice to Contractor and Engineer. Such notice will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be entitled to an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension. Any Change Proposal seeking such adjustments shall be submitted no later than 30 days after the date fixed for resumption of Work.

16.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will constitute a default by Contractor and justify termination for cause:
 - 1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule);
 - 2. Failure of Contractor to perform or otherwise to comply with a material term of the Contract Documents;
 - 3. Contractor's disregard of Laws or Regulations of any public body having jurisdiction; or
 - 4. Contractor's repeated disregard of the authority of Owner or Engineer.
- B. If one or more of the events identified in Paragraph 16.02.A occurs, then after giving Contractor (and any surety) ten days written notice that Owner is considering a declaration that Contractor is in default and termination of the contract, Owner may proceed to:
 - 1. declare Contractor to be in default, and give Contractor (and any surety) notice that the Contract is terminated; and
 - 2. enforce the rights available to Owner under any applicable performance bond.
- C. Subject to the terms and operation of any applicable performance bond, if Owner has terminated the Contract for cause, Owner may exclude Contractor from the Site, take possession of the Work, incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere, and complete the Work as Owner may deem expedient.
- D. Owner may not proceed with termination of the Contract under Paragraph 16.02.B if Contractor within seven days of receipt of notice of intent to terminate begins to correct its failure to perform and proceeds diligently to cure such failure.
- E. If Owner proceeds as provided in Paragraph 16.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds the cost to complete the Work, including all related claims, costs,

losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- F. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue, or any rights or remedies of Owner against Contractor or any surety under any payment bond or performance bond. Any retention or payment of money due Contractor by Owner will not release Contractor from liability.
- G. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 6.01.A, the provisions of that bond shall govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

16.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
 - 1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 - 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses; and
 - 3. other reasonable expenses directly attributable to termination, including costs incurred to prepare a termination for convenience cost proposal.
- B. Contractor shall not be paid on account of loss of anticipated overhead, profits, or revenue, or other economic loss arising out of or resulting from such termination.

16.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (1) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (2) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (3) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the contract and recover from Owner payment on the same terms as provided in Paragraph 16.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the

Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

- A. *Disputes Subject to Final Resolution:* The following disputed matters are subject to final resolution under the provisions of this Article:
 - 1. A timely appeal of an approval in part and denial in part of a Claim, or of a denial in full; and
 - 2. Disputes between Owner and Contractor concerning the Work or obligations under the Contract Documents, and arising after final payment has been made.
- B. *Final Resolution of Disputes:* For any dispute subject to resolution under this Article, Owner or Contractor may:
 - 1. elect in writing to invoke the dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agree with the other party to submit the dispute to another dispute resolution process; or
 - 3. if no dispute resolution process is provided for in the Supplementary Conditions or mutually agreed to, give written notice to the other party of the intent to submit the dispute to a court of competent jurisdiction.

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

- A. When any period of time is referred to in the Contract by days, it will be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day will be omitted from the computation.

18.03 *Cumulative Remedies*

- A. The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto are in addition to, and are not to be construed in any way as a limitation of, any rights and remedies available to any or all of

them which are otherwise imposed or available by Laws or Regulations, by special warranty or guarantee, or by other provisions of the Contract. The provisions of this paragraph will be as effective as if repeated specifically in the Contract Documents in connection with each particular duty, obligation, right, and remedy to which they apply.

18.04 *Limitation of Damages*

- A. With respect to any and all Change Proposals, Claims, disputes subject to final resolution, and other matters at issue, neither Owner nor Engineer, nor any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, shall be liable to Contractor for any claims, costs, losses, or damages sustained by Contractor on or in connection with any other project or anticipated project.

18.05 *No Waiver*

- A. A party's non-enforcement of any provision shall not constitute a waiver of that provision, nor shall it affect the enforceability of that provision or of the remainder of this Contract.

18.06 *Survival of Obligations*

- A. All representations, indemnifications, warranties, and guarantees made in, required by, or given in accordance with the Contract, as well as all continuing obligations indicated in the Contract, will survive final payment, completion, and acceptance of the Work or termination or completion of the Contract or termination of the services of Contractor.

18.07 *Controlling Law*

- A. This Contract is to be governed by the law of the state in which the Project is located.

18.08 *Headings*

- A. Article and paragraph headings are inserted for convenience only and do not constitute parts of these General Conditions.

SECTION 00800 - SUPPLEMENTARY CONDITIONS

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These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC® C-700 (2013 Edition). All provisions that are not so amended or supplemented remain in full force and effect.

The terms used in these Supplementary Conditions have the meanings stated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings stated below, which are applicable to both the singular and plural thereof.

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

SC-4.04 Progress Schedule

SC-4.04. Delete Section 4.04 in its entirety and replace it with the following:

SC-4.04 Progress Schedule

- 1. At each progress pay request, the Contractor shall submit a revised schedule for all work remaining. The progress pay request shall not be paid until a satisfactory schedule update is approved by the Engineer. If, at any time, the Engineer considers the project completion date to be in jeopardy because of activities behind schedule, the Contractor shall submit additional schedules and diagrams indicating how the Contractor intends to accomplish the remaining work to meet the Contract completion date.**
- 2. All change orders, regardless of origin, shall be reflected in the schedule.**
- 3. Schedule Revisions: The conditions under which the Engineer will require revisions of the Progress Schedule include the following:**
 - a. When delay in completion of any work item or sequence of work items results in an estimated extension of project completion by either twenty (20) working days or by five percent (5%) of the remaining duration of time to complete the Contract, whichever is less.**
 - b. When delays in submittals or deliveries make re-planning 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 a schedule revision.**
- 4. Weekly Progress Meetings and Weekly Activities Plan: Weekly progress meetings will be held, and at each weekly meeting, the Contractor shall submit to the Engineer the Contractor's Plan of Activities for the following week. The Plan of Activities shall describe the activity and location of the activity.**

SC-4.05. Delete Section 4.05 in its entirety and replace it with the following:

SC-4.05 Time of Completion, Delays in the Work, and Liquidated Damages

A. Time of Completion – Ordering Equipment

Submittals for equipment items that require long lead times (4 weeks or longer) shall be processed in an expeditious as possible manner by the Contractor and the Owner. The Contractor will provide evidence to the Owner, once order(s) are placed, of the delivery date of the equipment items to the work site. If the delivery dates extend the project completion date beyond the contract time, the Owner will approve an extension to contract time provided that the Contractor has performed the following:

1. **Complete all other work except for the late delivery items; including foundations for late delivery items.**
2. **Payments to manufacturers to expedite manufacturing and delivery of the various items.**
3. **Provide documentation at time of ordering of construction work that shows the impact of the late delivery items on the contract completion date.**

The Owner reserves the right to limit any extension of contract time just to the work items reasonably expected to be directly associated with installation and completion of the late delivery items.

B. Delays in the Work

1. Excusable Delays

Delays caused by acts of God, fire, unusual storms, floods, earthquakes, strikes, labor disputes, freight embargoes, and shortages of materials shall be considered as excusable delays insofar as they prevent the Contractor from proceeding with at least seventy-five percent (75%) of the normal labor and equipment force for at least five (5) hours per day toward completion of the current critical activity item(s) on the latest favorably reviewed progress schedule.

Upon the submission of satisfactory proof to the Engineer by the Contractor, shortages of material will be acceptable as grounds for granting a time extension. In order that such proof may be satisfactory and acceptable to the Engineer, it must be demonstrated by the Contractor that the Contractor has made every effort to obtain such materials from all known sources within reasonable reach of the proposed work. Only the physical shortage of material, caused by unusual circumstances, will be considered under these provisions as a cause for extension of time, and no consideration will be given to any claim that material could not be obtained at a reasonable, practical, or economical cost or price, unless it is shown to the satisfaction of the Engineer that such material will not be considered for material ordered or delivered late or whose availability is affected by virtue of

the mishandling of procurement. The above provisions apply equally to equipment to be installed in the work.

2. Unexcused Delays

Unexcused delays in the prosecution of the work shall include delays, which could have been avoided by the exercise of care, prudence, foresight, and diligence on the part of the Contractor or its subcontractors, at any tier level, or suppliers.

3. Time Extensions for Excusable Delays:

If the Contractor experiences an excusable delay, then the Contract completion date may be extended by the Engineer for such time that, in the Engineer's determination, the Contractor's completion date will be delayed, provided that the Contractor strictly fulfills the following:

- a. The Contractor shall provide notification, in writing a request for an extension of time to the Engineer stating at a minimum the probable cause of the delay and the number of days being requested. The time extension request shall be submitted along with a Time Impact Analysis which shall include the following:
 - (1) An analysis demonstrating how the Contractor proposes to incorporate the delay into the schedule.
 - (2) The analysis shall demonstrate the time impact based on the date of occurrence of the delay; the status of construction at that point in time; and the impact of all affected activities.
- b. If requested by the Engineer, the Contractor shall promptly provide sufficient information to the Engineer to assess the cause or effect of the alleged delay, or to determine if other concurrent delays affected the work.
- c. The Contractor will be granted a non-compensable time extension for weather caused delays.
- d. Should the Contractor fail to fulfill any of the foregoing, which are conditions precedent to the right to receive a time extension, the Contractor waives the right to receive a time extension.
- e. Neither, compensation for engineering, inspection, and administration, nor damages for delay will be charged to the Contractor for such extension of time. It is understood and agreed by the Contractor and Engineer that time extensions due to excusable delays will be granted only if such delays involve controlling operations which would prevent completion of the whole work within the specified Contract time.

C. Liquidated Damages

It is agreed by the parties to the Contract that time is of the essence; and that in case all the work is not completed before or upon the expiration of the time limit as set in the Contract, or within any time extensions that may have been granted, damage will be sustained by the Owner; and that it may be impracticable to determine the actual amount of damage by reason of such delay. Accordingly, it is agreed that the Contractor shall pay to the Owner as damages in the amount described in Section 00520, Paragraph 4.03. The Owner shall have the right to deduct the amount of liquidated damages from any money due or to become due the Contractor.

Notwithstanding the above, the Contractor shall not be liable for liquidated damages or delays caused by the removal or relocation of utilities when such removal or relocation is the responsibility of the Owner or the owner of the utility under Government Code § 4215.

ARTICLE 5 – AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS

SC-5.03 *Subsurface and Physical Conditions*

SC-5.03. Add the following new paragraphs immediately after Paragraph 5.03B:

SC -5.03 Subsurface and Physical Conditions

- C. The following reports of explorations and tests of subsurface conditions at or adjacent to the Site are known to the Owner:
 - 1. Report dated June 22, 2016, prepared by Geo-Logic Associates, Morgan Hill, CA, entitled: “Geotechnical Investigation, City of East Palo Alto, Pad D Municipal Well Project”. The Technical Data contained in the above report upon whose accuracy Contractor may rely are those indicated in the definition of Technical Data in the General Conditions.
- D. Contractor may examine copies of reports and drawings identified in SC 5.03.C that were not included with the Bidding Documents at City of East Palo Alto, 2415 University Avenue, East Palo Alto, CA 94303 during regular business hours, or may request copies from Engineer, at the cost of reproduction.

SC-5.06 *Hazardous Environmental Conditions*

SC 5.06 Delete Paragraphs 5.06.A and 5.06.B in their entirety and insert the following:

- A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.
- B. Not Used.

ARTICLE 6 – BONDS AND INSURANCE

SC-6.03 Contractor's Liability Insurance

SC 6.03.B Add the following to the list of requirements in Paragraph 6.03.I, as a numbered item.

4. Claims for owned and non-owned equipment, blanket contractual liability, completed operations liability, explosion, collapse, underground excavation, and removal of lateral support.

SC 6.03.C Replace Paragraph 6.03.C.1.b with the following:

Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and ten years thereafter.

SC 6.03.D Add the following sentence to the end of Paragraph 6.03.D:

The automobile liability policy shall cover all owned, non-owned, and hired automobiles.

SC 6.03.G In the first sentence of Paragraph 6.03.G, replace “any individuals or entities identified in the Supplementary Conditions” with “City of East Palo Alto, EKI Environment & Water, Inc. and Freyer & Laureta, Inc., and each entity’s directors, officers, employees, and authorized volunteers”.

SC 6.03.I Add the following to the list of requirements in Paragraph 6.03.I, as numbered items:

6. For general liability, auto liability, and excess liability policies, the policies are to obtain or be endorsed to contain the following provisions:
 - (a) Any failure to comply with reporting or other provisions of the policies including breaches of warranties shall not affect coverage provided to Additional Insureds.
 - (b) The 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.

Such liability insurance shall indemnify the Contractor and its subcontractors against loss from liability imposed by law upon, or assumed under contract by, the Contractor and its subcontractor on account of bodily injury (including death), property damage, personal injury, completed operations, and products liability.

7. For workers compensation and employer’s liability insurance policies, Contractor shall assume the immediate defense of and indemnify and save harmless Owner, Engineer, and Additional Insureds from all claims, loss, damage, injury, and liability of every kind, nature, and description brought by any person employed or used by Contractor, or any subcontractor, to perform the Work under this contract regardless of responsibility or negligence. Contractor shall waive rights of subrogation which any insurer of Contractor may acquire from Contractor by virtue of the payment of any loss. Contractor agrees to obtain any endorsement that may be necessary to effect this waiver of subrogation. The Workers’ Compensation Policy shall be endorsed with a waiver of subrogation in favor of

Owner, Engineer, and Additional Insureds for all work performed by Contractor, its employees, agents, and subcontractors.

SC 6.03 Add the following new paragraph immediately after Paragraph 6.03.J:

K. The limits of liability for the insurance required by Paragraph 6.03 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

1. Workers' Compensation, and related coverages under Paragraphs 6.03.A.1 and A.2 of the General Conditions:

The Contractor and all subcontractors shall maintain insurance to protect the Contractor or subcontractor from all claims under Worker's Compensation and Employer's Liability Acts with limits the greater of the statutory requirements, or one million dollars (\$1,000,000) per accident and, for bodily injury by disease, one million (\$1,000,000) per employee. Coverage shall include all work covered under the Longshoremen's and Harbor Workers' Act. Such coverage shall be maintained, in type and amount, in strict compliance with all applicable State and Federal statutes and regulations. The Contractor shall execute a certificate in compliance with Labor Code section 1861.

2. Contractor's Commercial General and Automobile Liability under Paragraphs 6.03.B, 6.03.C, and 6.03.D of the General Conditions:

General Liability – Two million dollars (\$2,000,000) per occurrence and four million dollars (\$4,000,000) aggregate or the full per occurrence limits of the policies available, whichever is greater for bodily injury, personal injury and property damage. If Commercial General Liability Insurance or other form with a general aggregate limit or products-completed operations aggregate limit is used, either the general aggregate limit shall apply separately to the project/location (with the ISO CG 2503, or ISO CG 2504, or insurer's equivalent endorsement provided to Owner) or the general aggregate limit and products-completed operations aggregate limit shall be twice the required occurrence limit.

Automobile Liability – Two million dollars (\$2,000,000) for bodily injury and property damage each accident limit.

4. Excess or Umbrella Liability:

The limits of Insurance required in this agreement may be satisfied by a combination of primary and umbrella or excess Insurance. Any umbrella or excess Insurance shall contain or be endorsed to contain a provision that such coverage shall also apply on a primary and non-contributory basis for the benefit of the District (if agreed to in a written contract or agreement) before the District's own primary or self-insurance shall be called upon to protect it as a named insured.

5. Contractor's Pollution Liability:

Contractor is not required to provide Contractor's Pollution Liability insurance under this Contract.

6. Additional Insureds: In addition to Owner and Engineer, include as

additional insureds the following: City of East Palo Alto, EKI Environment & Water, Inc. and Freyer & Laureta, Inc., and each entity's directors, officers, employees, and authorized volunteers.

7. Contractor's Professional Liability:

Contractor is not required to provide Contractor's Professional Liability insurance under this Contract.

SC-6.05 Property Insurance

SC-6.05.A.1 Add the following new subparagraph after subparagraph 6.05.A.1:

- a. In addition to Owner, Contractor, and all Subcontractors, include as insureds the Additional Insureds described in subparagraph SC-6.03G.

SC-6.05.A. Add the following to the list of requirements in Paragraph 6.05.A, as numbered items:

14. be subject to a deductible amount to be approved by the Owner, except that the deductible on earthquake coverage may be in accordance with the underwriter's requirements.
15. include for the benefit of Owner loss of profits and soft cost coverage including, without limitation, fixed expenses and debt service for a minimum of 12 months with a maximum deductible of 30 days, plus attorneys fees and engineering or other consultants' fees, if not otherwise covered.
16. include by express endorsement coverage of damage to Contractor's equipment
17. include, as listed in the Contract Price, the value of equipment whose contracts have been assigned to the Contractor as part of this construction project.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

SC-7.02 Labor; Working Hours

SC-7.02.B. Add the following new subparagraphs immediately after Paragraph 7.02.B:

1. Regular working hours shall be limited to between 8:00 am and 6:00 pm on weekdays, unless otherwise approved by Engineer. Contractor shall notify the Engineer at least 72 hours prior to any work outside the normal working hours defined above, on weekends or holidays.
2. Contractor shall be responsible for any inspection and additional administration costs incurred by the Owner or its agents and representatives for work by the Contractor after the hours defined above on weekdays, or any work on weekends or holidays recognized by the Owner. Such costs shall be withheld from the succeeding monthly progress payment.

SC-7.08 Permits

SC-7.08 Add the following new subparagraphs immediately after Subparagraph 7.08.A:

- B. Contractor shall also furnish the Engineer a copy of a valid, current City of East Palo Alto Business License prior to the commencement of the work. Details may be found at <http://www.ci.east-palo-alto.ca.us/index.aspx?nid=221> or by

following these screens: Homepage (www.ci.east-palo-alto.ca.us) > > Doing Business > Business Licenses.

- C. The Environmental Quality Act (Public Resources Code, Section 2100 to 21176, Inclusive) may be applicable to permits, licenses and other authorizations which the Contractor must obtain from local agencies in connection with performing the work of the contract. The Contractor shall comply with the provisions of said statutes in obtaining such permits, licenses and other authorizations and they shall be obtained in sufficient time to prevent delays to the work.

SC-7.10 *Laws and Regulations*

SC-7.10 Add the following new subparagraphs immediately after Subparagraph 7.10.C:

- D. **Prevailing Wages:** Pursuant to section 1770 et seq. of the Labor Code of the State of California, the Director of Industrial Relations has ascertained the general prevailing rate of per diem wages and the rates for overtime and holiday work in the locality in which the work is to be performed for each craft, classification or type of worker needed to execute the contract which will be awarded to the successful bidder. Copies are on file with and available upon request from the Engineer and are also available at the following State of California website: <https://www.dir.ca.gov/OPRL/DPreWageDetermination.htm>. The successful bidder shall post a copy thereof at each job site. It shall be mandatory upon the bidder to whom the Contract is awarded, and upon any subcontractor under him to comply with all Labor Code provisions, which include, but are not limited to the payment of not less than the said specified rates to all workers employed by them in the execution of the Contract, employment of apprentices, hours of labor and debarment of contractors and subcontractors.

The Contractor shall forfeit as penalty not more than Two Hundred dollars (\$200) for each calendar day, or portion thereof, for each worker (whether employed by the Contractor or subcontractor) paid less than the stipulated prevailing rates for any work done under the Contract in violation of the provisions of the Labor Code and in particular, Section 1775.

The Owner will not recognize or be liable for any claims for additional compensation because of the payment of the wages set forth in the Contract Documents or Contractor's failure to pay prevailing wages. The possibility of wage increases is one of the elements to be considered by the Contractor in determining its Bid, and will not under any circumstances be considered as the basis of a claim against the Owner or the Engineer.

- E. **Labor Discrimination:** Attention is directed to Section 1735 of the Labor Code, which reads as follows:

No discrimination shall be made in the employment of persons upon public works because of the race, religious creed, color, national origin, ancestry, physical disability, mental disability, medical condition, marital status, or sex of such persons, except as provided in Section 12940 of the Government Code, and every Contractor for

public works violating this section is subject to all the penalties imposed for a violation of this chapter.

- F. **Employment of Debarred Subcontractors:** Pursuant to Section 6109 of the Public Contract Code, an ineligible contractor may not perform work on a public works project, such as this Project, or perform work with a subcontractor who is ineligible to perform work on a public works project pursuant to Section 1777.1 or 1777.7 of the Labor Code. This list of debarred contractors is available from the State Department of Industrial Relations web site at:

<http://www.dir.ca.gov/DLSE/Debar.html>

- G. **Eight-Hour Day Limitation:** In accordance with the provisions of the Labor Code, and in particular, Sections 1810 to 1815 thereof, inclusive, eight hours labor shall constitute a day's work, and no worker, in the employ of said Contractor, or any subcontractor, doing or contracting to do any part of the work contemplated by this Contract, shall be required or permitted to work more than eight (8) hours in any one calendar day and forty (40) hours in any one calendar week in violation of those provisions; provided that subject to Labor Code Section 1815, a worker may perform work in excess of either eight (8) hours per day or forty (40) hours during any one week upon compensation for all hours worked in excess of eight (8) hours per day or forty (40) hours during any one week at not less than one and one-half times the basic rate of pay.

The Contractor and each subcontractor shall keep an accurate record showing the names, addresses, social security numbers, work classifications, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by the Contractor and by the subcontractor in connection with the work specified herein, which record shall be open at all reasonable hours to the inspection of the City, State and Federal officers and agents; and it is hereby further agreed that, except as provided above, the Contractor shall forfeit as a penalty to the Owner the sum of twenty-five dollars (\$25) for each worker employed in the performance of this Contract by it or by any subcontractor under it for each calendar day during which such worker is required or permitted to labor more than eight (8) hours in any one calendar day and forty (40) hours in any one calendar week in violation of Sections 1810 through 1815.

- H. **Compliance with State Requirements for Employment of Apprentices:** The Contractor's attention is directed to Section 1777.2 through 1777.5 of the Labor Code; provisions of those Sections pertaining to employment of registered apprentices are hereby incorporated by reference into these Specifications. As applicable, the Contractor or any subcontractor employed by it in the performance of the Contract work shall take such actions as necessary to comply with the provisions of Section 1777.5.
- I. **Other Labor Code Requirements:** 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 the Labor Code Section 1725.5.

As described below, all contractors and subcontractor must furnish electronic certified payroll records directly to Labor Commissioner once monthly. In addition, the contractor and subcontractors must submit the certified payroll records to the City's Labor Compliance Consultant for review.

1. Pursuant to Labor Code section 1776, as amended from time to time, the Contractor and each subcontractor shall keep records showing the name, address, social security number, work classification, straight time and overtime hours paid each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker or other employee employed by him or her in connection with the work. The certified payroll records shall be on forms provided by the Division of Labor Standards Enforcement or shall contain the same information as the forms provided by the Division.
2. The payroll records shall be certified and shall be available for inspection at all reasonable hours at the principal office of the Contractor on the following basis:
 - (a) A certified copy of the employee's payroll records shall be made available for inspection or furnished to such employee or his or her authorized representative on request.
 - (b) A certified copy of all payroll records shall be made available for inspection or furnished upon request, or as required by Labor Code section 1771.7 to the City, the Division of Labor Standards Enforcement and the Division of Apprenticeship Standards of the Department of Industrial Relations.
 - (c) A certified copy of all payroll records shall be made available upon request to the public for inspection or copies thereof made; provided, however, that if request by the public shall be made through either the City, the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement, if as requested, payroll records have been provided pursuant to paragraph (b), the requesting party shall, prior to being provided the records, reimburse the cost of preparation by the Contractor, subcontractors and the entity through which the request was made. The public shall not be given access to such records at the principal office of the Contractor.

3. The Contractor shall file a certified copy of the payroll records with the entity that requested such records within ten (10) calendar days after receipt of a written request.
 4. Any copy of records made available for inspection as copies and furnished upon request to the public or the City, the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement, shall be marked or obliterated in such a manner as to prevent disclosure of an individual's name, address, and social security number. The name and address of the Contractor or any subcontractor performing work on the Project shall not be marked or obliterated.
 5. The Contractor shall inform the City of the location of the payroll records, including the street address, city and county, and shall, within five (5) calendar days, provide a notice of a change of location and address.
 6. In the event of noncompliance with the requirements of this section, the Contractor shall have ten (10) calendar days in which to comply subsequent to receipt of written notice specifying in what respects the Contractor must comply with this section. Should noncompliance still be evident after such ten (10) calendar day period, the Contractor shall, as a penalty to the City, forfeit one hundred dollars (\$100) for each calendar day, or portion thereof, for each worker until strict compliance is effectuated. Upon the request of the Division of Labor Standards Enforcement, such penalties shall be withheld from payments due Contractor.
- J. **Underground Utilities:** All excavations shall be conducted by Contractor or any subcontractor in accordance with the procedures set forth in applicable law, including Government Code section 4216 et. seq. governing protection of underground infrastructure.
- K. **Water Pollution:** The Contractor shall comply with the provisions of Chapter 13.12, Stormwater Management and Discharge of the City of East Palo Alto Municipal Code.

The Contractor shall exercise every reasonable precaution to protect streams, lakes, reservoirs, bays, and coastal waters from pollution with fuels, oils, bitumens, calcium chloride and other harmful materials and shall conduct and schedule operations so as to avoid or minimize muddying and silting of streams, lakes, reservoirs, bays and coastal waters. Care shall be exercised to preserve adjacent vegetation beyond the limits of construction.

Water pollution control work is intended to provide prevention, control and abatement of water pollution to streams, waterways and other bodies of water, and shall consist of constructing those facilities which may be shown on the plans, specified herein or in the special provisions, or directed by the Engineer.

In order to provide effective and continuous control of water pollution it may be necessary for the Contractor to perform the contract work in small or

multiple units, on an out of phase schedule, and with modified construction procedures. The Contractor shall provide temporary water pollution control measures, including but not limited to, dikes, basins, ditches, and applying straw and seed, which become necessary as a result of the Contractor's operations. The Contractor shall coordinate water pollution control work with all other work done on the contract.

Before starting any work on the project, the Contractor shall submit, for acceptance by the Engineer, a program to control water pollution effectively during construction of the project. The program shall show the schedule for the erosion control work included in the contract and for all water pollution control measures which the Contractor proposes to take in connection with construction of the project to minimize the effects of the operations upon adjacent streams and other bodies of water. The Contractor shall not perform any clearing and grubbing or earthwork on the project, other than that specifically authorized in writing by the Engineer, until the program has been accepted.

If the measures being taken by the Contractor are inadequate to control water pollution effectively, the Engineer may direct the Contractor to revise the operations and the water pollution control program. The directions will be in writing and will specify the items of work for which the Contractor's water pollution control measures are inadequate. No further work shall be performed on those items until the water pollution control measures are adequate and, if also required, a revised water pollution control program has been accepted.

The Engineer will notify the Contractor of the acceptance or rejection of any submitted or revised water pollution control program in not more than 5 working days.

The Owner will not be liable to the Contractor for failure to accept all or any portion of an originally submitted or revised water pollution control program, nor for any delays to the work due to the Contractor's failure to submit an acceptable water pollution control program.

The Contractor may request the Engineer to waive the requirement for submission of a written program for control of water pollution when the nature of the Contractor's operation is such that erosion is not likely to occur. Waiver of this requirement will not relieve the Contractor from responsibility for compliance with the other provisions of this section. Waiver of the requirement for a written program for control of water pollution will not preclude requiring submittal of a written program at a later time if the Engineer deems it necessary because of the effect of the Contractor's operations.

Unless otherwise approved by the Engineer in writing, the Contractor shall not expose a total area of erodible earth material, which may cause water pollution, exceeding 1 acre (45,000 square feet) for each separate location, operation or spread of equipment before either temporary or permanent erosion control measures are accomplished.

Where erosion which will cause water pollution is probable due to the nature of the material or the season of the year, the Contractor's operations shall be so scheduled that permanent erosion control features will be installed concurrently with or immediately following grading operations.

Nothing in the terms of the contract nor in the provisions in this Section shall relieve the Contractor of the responsibility for compliance with Sections 5650 and 12015 of the Fish and Game Code, or other applicable statutes relating to prevention or abatement of water pollution.

When borrow material is obtained from other than commercially operated sources, erosion of the borrow site during and after completion of the work shall not result in water pollution. The material source shall be finished, where practicable, so that water will not collect or stand therein.

The requirements of this section shall apply to all work performed under the contract and to all non-commercially operated borrow or disposal sites used for the project.

The Contractor shall also conform to the following provisions:

1. Where working areas encroach on live streams, barriers adequate to prevent the flow of muddy water into streams shall be constructed and maintained between working areas and streams, and during construction of the barriers, muddying of streams shall be held to a minimum.
2. Removal of material from beneath a flowing stream shall not be commenced until adequate means, such as a bypass channel, are provided to carry the stream free from mud or silt around the removal operations.
3. Should the Contractor's operations require transportation of materials across live streams, the operations shall be conducted without muddying the stream. Mechanized equipment shall not be operated in the stream channels of the live streams except as may be necessary to construct crossings or barriers and fills at channel changes.
4. Water containing mud or silt from aggregate washing or other operations shall be treated by filtration, or retention in a settling pond, or ponds, adequate to prevent muddy water from entering live streams.
5. Oily or greasy substances originating from the Contractor's operations shall not be allowed to enter or be placed where they will later enter a live stream.
6. Portland cement or fresh portland cement concrete shall not be allowed to enter flowing water of streams.
7. When operations are completed, the flow of streams shall be returned as nearly as possible to a meandering thread without creating possible future bank erosion, and settling pond sites

shall be graded so they will drain and will blend in with the surrounding terrain.

8. Material derived from roadway work shall not be deposited in a live stream channel where it could be washed away by high stream flows.
9. Where there is possible migration of anadromous fish in streams affected by construction on the project, the Contractor shall conduct work operations so as to allow free passage of the migratory fish.

Compliance with the provisions in this section shall in no way relieve the Contractor from the responsibility to comply with the other provisions of the contract, in particular the responsibility for damage and for preservation of property.

Full compensation for conforming to the provisions in this section shall be considered as included in the prices paid for the various items of work and no additional compensation will be allowed therefore.

SC-7.11 Record Documents

SC 7.11 Add the following new paragraph immediately after Paragraph 7.11.A:

- B. The Contractor shall prepare Record Drawings by neatly adding the following information in ink at least once a week to a set of Contract Drawings: (1) references to Contract modifications including Responses to Request For Information, minor changes and Change Orders; (2) as-built work that differs from work shown on the Contract Drawings; and (3) the dimensioned, as-installed location of major underground and concealed utilities, conduits, piping, tanks, facilities and similar items. Record Drawings shall be made on a clean copy of the Contract Drawings and not used for any other purposes. The Contractor shall make Record Drawings available to the Engineer to verify progress. Upon substantial completion the Contractor shall review Record Drawings for accuracy and completeness, which includes surveying of utilities. All survey Record Drawing information shall be submitted to the Engineer in AutoCAD format. The Contractor shall submit and obtain favorable review of the Record Drawings prior to Final Acceptance.

SC-7.16 Shop Drawings, Samples, and Other Submittals

SC 7.16.C Delete Paragraph SC-7.16.C in its entirety and replace it with the following:

SC-7.16.C Transmittal Procedures

1. Transmittal Form

A separate transmittal form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Submittal documents common to more than one piece of equipment shall be identified with all the appropriate equipment numbers. Submittals for various items shall be made with a single form when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group

or package as a whole. The specification section to which the submittal is related shall be indicated on the transmittal form.

A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted. Original submittal numbers shall have the following format: "XXX"; where "XXX" is the sequential number assigned by the Contractor. Resubmittals shall have the following format: "XXX-Y"; where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25B, for example, is the second resubmittal of submittal 25.

2. Deviations from the Contract

If the submittals show any deviations from the Contract requirements, the Contractor shall submit with the submittal submission a separate written description of such deviations and the reasons therefore. If the Owner accepts such deviation, the Owner shall issue an appropriate Contract Change Order, except that, if the deviation is minor, or does not involve a change in price or in time of performance, a Change Order need not be issued. If any deviations from the Contract requirements are not noted on the shop drawing, the review of the submittal shall not constitute acceptance of such deviations.

3. Substantial Completeness

The Contractor shall check all submittals before submitting them to the Engineer and shall certify on the transmittal letter and on each submittal that they have been checked, are in compliance with the Plans and Specifications, and all deviations from the Contract requirements are noted.

If the Contractor submits an incomplete submittal, the submittal will be returned to the Contractor without review. A complete submittal shall contain sufficient data to demonstrate that the items comply with the Specifications, shall meet the minimum requirements for submissions cited in the technical specifications, shall include materials and equipment data and seismic anchorage certifications where required, and shall include any necessary revisions required for equipment other than first named manufacturer.

It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the Engineer at least by the second submission of data. The Owner reserves the right to deduct monies from payments due the Contractor to cover additional costs of review beyond the second submission.

SC 7.16.D Add the following to the list of requirements in Paragraph 7.16.D, as numbered items.

- 9. Submittals shall be submitted to the Engineer for review and generally returned within ten (10) working days after receipt. Review of submittals by the Engineer has as its primary objective the completion for the Owner of a project in full conformance with the Contract Plans and Specifications, unmarred by field corrections, and within the time provided. In addition to this primary objective, submittals review as a secondary objective will assist**

the Contractor in its procurement of equipment that will meet all requirements of the project Plans and Specifications, will fit the structures detailed on the Plans, will be completed with respect to piping, electrical, and control connections, will have the proper functional characteristics, and will become an integral part of a complete operating facility. Acceptance of submittals does not constitute a change order to the Contract requirements.

10. After review by the Engineer of each of the Contractor's submissions, the material will be returned to the Contractor with actions defined as follows:

a. No Exception Taken:

Accepted subject to its compatibility with future submissions and additional partial submissions for portions of the work not covered in this submission. Does not constitute approval or deletion of specified or required items not shown in the partial submission.

b. Make Corrections Noted

Same as a, except that minor corrections as noted shall be made by the Contractor.

c. Amend and Resubmit

Major corrections as noted shall be revised and resubmitted by the Contractor.

d. Reject and Resubmit

Rejected because of major inconsistencies or errors which shall be resolved or corrected by the Contractor prior to subsequent review by the Engineer.

e. Comments Attached (Resubmit)

Submitted material does not conform to Plans and Specifications in major respect, i.e. wrong size, model, capacity, or material.

Items a and b above (no resubmittal required) are considered "favorable review." Items c, d, and e above (correction and resubmittal required) are considered "unfavorable review."

It shall be the Contractor's responsibility to copy and/or conform reviewed submittals in sufficient numbers for its files, subcontractors, and vendors.

SC 7.16.F Add the following new paragraph immediately after Paragraph 7.16.E:

F. *Engineer's Favorable Review:* The Engineer's favorable review of submittals shall be obtained prior to the fabrication, delivery and construction of items submittal. Favorable review of submittals does not constitute a change order to the Contract requirements. The favorable review of all submittals by the Engineer shall apply in general design only and shall in no way relieve the Contractor from responsibility for errors or omissions contained therein. Favorable review by the Engineer shall not relieve the Contractor of its obligation to meet safety requirements and all other requirements of laws, nor constitute a Contract Change Order. Favorable review by the Engineer will not constitute acceptance by the Engineer of any responsibility for the

accuracy, coordination, and completeness of the submittals or the items of equipment represented on the submittals.

SC-7.17 Contractor's General Warranty and Guarantee

SC-7.17 Add the following new subparagraph immediately after Paragraph 7.17.D:

- E. Upon completion of the contract, Contractor shall furnish a Maintenance Bond conditioned to guarantee for the period of one (1) year after acceptance of the project by the Owner, against all defects in workmanship and materials which may become apparent during said period.**

SC-7.18 Indemnification

SC-7.18 Delete Paragraph 7.18.A in its entirety and replace it with the following:

- A. To the fullest extent permitted by law and equity, the Contractor shall indemnify, promptly defend, and hold harmless the Owner, Engineer, and Additional Insureds, and each of their respective officials, officers, directors, principals, agents, managers, members, consultants, and employees (collectively the "Indemnities"), against and from all claims, damages, losses, and expenses, including but not limited to fees and charges of attorneys and court mediation and arbitration costs, arising out of, in connection with, or resulting from the acts, omissions, negligence, or willful or reckless misconduct of the Contractor, any Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, in connection with performance under this Agreement, except to the extent caused by the sole negligence or willful misconduct of the Indemnities.**

The Contractor shall reimburse the Indemnities for all costs and expenses (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals and court mediation and arbitration costs) incurred by said Owner, Engineer, and Additional Insureds, in defending themselves against any such claim or liability or in enforcing the Contractor's obligations under this Paragraph 7.18.

SC-7.18 Delete Paragraph 7.18.C in its entirety.

SC-7.20 Escrow of Bid Documents

SC-7.20 Add the following new paragraph immediately after Paragraph 7.19 of the General Conditions:

SC-7.20 Escrow of Bid Documents

- A. As alluded to in Article 23 of Section 00200, Instructions to Bidders, the Contractor is required to submit one (1) copy of all documentary information generated in preparation of the bid price for the Project to the Engineer to be held in escrow of the duration of the Contract within three (3) working days of bid opening. This material is hereinafter referred to as "Escrow Bid Documents." The "Escrow Bid Documents" shall include, but not be limited to any documents, pictures, or writings which relate to, arise out of, or constitute in any way notes, memoranda, phone logs, subcontractor and materialmen estimates, computations, or the like used by,**

complied by, or drafted by the Contractor or its agents in arriving at its bid for the Project. Such documentation shall be presented in a sealed envelope or box. The Escrow Bid Documents will be held in escrow of the duration of the Contract. The Escrow Bid Documents shall not change or modify the terms or conditions of the Contract.

1. Confidential Information

- a. The Escrow Bid Documents are and will always remain the property of Contractor, subject only to joint review by the Owner and the Contractor, as provided below. The Owner stipulates and expressly acknowledges that the Escrow Bid Documents constitute trade secrets and are proprietary and confidential. This acknowledgment is based on the Owner's express understanding that the information contained in the Escrow Bid Documents is not known outside the Bidder's business, is known only to a limited extent and only by a limited number of employees of the Bidder, is safeguarded while in Bidder's possession, is extremely valuable to Bidder and could be extremely valuable to Bidder's competitors by virtue of it reflecting Bidder contemplated techniques of construction. As such, the Owner agrees to safeguard the Escrow Bid Documents and all the information contained to the extent not subject to disclosure under applicable law such as, but not limited to the California Public Records Act, Government Code Section 900 et seq.
- b. In the event of arbitration or litigation, the bid documentation shall be subject to discovery, and the Owner assumes no responsibility for safeguarding the bid documentation unless the Contractor has obtained an appropriate protective order issued by the arbitrator or the court.

2. Format and Contents

- a. Contractor may submit Escrow Bid Documents in the usual cost-estimating format. Escrow Bid Documents were required to be submitted in a form adequate to enable complete understanding and proper interpretation for their intended use.
- b. Escrow Bid Documents shall clearly itemize the estimated costs of performing the work. Items shall be separated into sub-items as required to present a complete and detailed cost estimate and allow a detailed cost review. The Escrow Bid Documents shall include all quantity takeoffs, labor, equipment, calculations of rate production and progress, copies of quotations from the Contractor and suppliers, and memoranda, narratives, consultant's reports, add/deduct sheets, and all other information used by the Contractor to arrive at the prices contained in the bid proposal. Estimated costs shall be broken down into the Contractor usual estimate categories such as direct labor, repair labor, material, equipment, construction equipment operation, construction equipment ownership, expendable materials, materials and Contractor's cost as appropriate. Plant and equipment, indirect

costs shall be detailed in the Contractor's usual format. The Contractor's allocation of plant and equipment, indirect costs, contingencies, markup and other items shall be included.

- c. All costs shall be identified for all items. Sub-items amounting to less than \$100,000.00 estimated unit costs are acceptable without a detailed cost estimate, provided that labor, equipment, materials, construction equipment, expendable materials and subcontracts, as applicable, are included, and provided that indirect costs, contingencies, and mark-up as applicable, are allocated.
- d. If the Contractor's proposal is based on subcontracting any part of the work and the total subcontract price exceeds the lesser of five percent (5%) of the total contract price proposed by the Contractor or \$200,000, Contractor shall provide separate Escrow Bid Documents for such subcontractor work to be submitted with those of the Contractor. These submittals will be examined in the same manner and at the same time as the examination described above. If the Contractor wishes to subcontract any portion of the work or requests substitutions after award, the Owner retains the right to require the Contractor to submit Escrow Bid Documents from the proposed subcontractor before the subcontract or substitution is approved.
- e. Bidding materials provided by the Owner shall not be included in the Escrow Bid Documents unless needed to comply with the requirements of this specification.

3. Submittal

- a. The Escrow Bid Documents shall be accompanied by an index to inventory the contents of the submittal and a Bid Documentation Certification, signed by the individual who executed the bidding proposal, stating that the material in the Escrow Bid Documents constitutes all documentary information used in preparation of the bid and that he/she has personally examined the contents of the Escrow Bid Documents container and has found the documents in the container(s) are complete and organized as shown by the Contractor's index.
- b. The Owner shall examine the Index. This examination is to ensure that the index is detailed and complete and conforms to the provisions set forth in this Section. If all the documentation required has not been indexed in the original submittal a revised Index shall be submitted at the Owner's discretion.

4. Storage

- a. The Escrow Bid Documents will be placed in escrow in a mutually agreeable institution. The Owner will pay the cost of storage.
- b. The bid documentation submitted by the Contractor will be held in escrow until the contract has been completed, the ultimate resolution

of all disputes and claims has been achieved and receipt of final payment has been accepted by the Contractor. The escrowed bid documentation will then be released from escrow to the Contractor.

5. Examination

- a. The Escrow Bid Documents shall be examined by the Owner, the Engineer and the Contractor, at any time deemed necessary by either the Owner or the Contractor, to assist in the negotiation for the settlement of claims.
- b. Examination of the Escrow Bid Documents is subject to the following conditions:
 - (i) As trade secrets, the Escrow Bid Documents are proprietary and confidential as described above.
 - (ii) The Owner and the Contractor shall each designate, in writing to the other party and a minimum of five (5) days prior to examination, representatives who are authorized to examine the Escrow Bid Documents. No other person shall have access to the Escrow Bid Documents.
 - (iii) Access to the Escrow Bid Documents under this paragraph will take place only in the presence of duly designed representatives of both the Owner and the Contractor.

6. Final Disposition

- a. The bid documentation submitted by the Contractor will be held in escrow until the Contract has been completed, the ultimate resolution of all disputes and claims has been achieved and receipt of final payment has been accepted by the Contractor. The Owner will then release the Escrow Bid Documents from escrow to the Contractor.

SC-7.21 Construction Staking and Surveys

SC-7.21 Add the following new paragraph immediately after Paragraph 7.20 of the General Conditions:

SC-7.21 Construction Staking and Surveys

The Contractor shall provide all construction staking and layout for the project.

ARTICLE 9 – OWNER’S RESPONSIBILITIES

SC-9.13 Owner’s Site Representative

SC-9.13 Add the following new paragraph immediately after Paragraph 9.12 of the General Conditions:

SC-9.13 Owner will furnish an “Owner’s Site Representative” to represent Owner at the Site and assist Owner in observing the progress and quality of the Work. The Owner’s Site

Representative is not Engineer's consultant, agent, or employee. Owner's Site Representative will be Jeff Tarantino, P.E..

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

SC-10.03 *Project Representative*

SC-10.03 Add the following new paragraphs immediately after Paragraph 10.03.A:

B. On this Project, Owner and Engineer shall designate Resident Project Representative (RPR). The RPR will act as directed by and under Engineer, and will confer with Engineer regarding RPR's actions.

- 1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.**
- 2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.**
- 3. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.**
- 4. Liaison:**
 - a. Serve as Owner's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.**
 - c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.**
- 5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.**
- 6. Shop Drawings and Samples:**
 - a. Record date of receipt of Samples and Contractor-approved Shop Drawings.**
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.**
 - c. Advise Owner, Engineer, and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.**

7. **Modifications:** Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to Owner and Engineer. Transmit to Contractor in writing decisions as issued by Owner and Engineer.
8. **Review of Work and Rejection of Defective Work:**
 - a. Conduct on-Site observations of Contractor's work in progress to assist Owner and Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Report to Owner whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Owner of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.
9. **Inspections, Tests, and System Start-ups:**
 - a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
 - b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.
10. **Records:**
 - a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
 - b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.
 - c. Maintain records for use in preparing Project documentation.
11. **Reports:**
 - a. Furnish to Owner periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.

- b. Draft and recommend to Owner proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.
 - c. Immediately notify Owner of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.
- 12. **Payment Requests:** Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Owner, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.
- 13. **Certificates, Operation and Maintenance Manuals:** During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.
- 14. **Completion:**
 - a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
 - b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
 - c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.
- C. **The RPR shall not:**
 - 1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
 - 2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
 - 3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
 - 4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of Contractor's work.

5. Advise on, issue directions regarding, or assume control over security or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

SC-10.10 Request for Information

SC-10.10 Add the following new paragraph immediately following Paragraph SC-10.9:

SC-10.10 Request for Information

The Engineer will endeavor to issue Responses to Requests for Information within 30 days of the date a Request for Information is received by the Engineer unless the Engineer requests more information from the Contractor in which case the Response will be issued 20 days after receipt of the additional information. The Engineer's Response to a Request for Information shall not authorize a change in Contract Time or Price. If the Contractor disagrees with the Engineer's interpretation of the Contract Documents, it shall notify the Engineer in writing within 20 days from receipt of Engineer's response. The Engineer shall not be required to answer Requests for Information when the information is contained in the Contract Documents or when the Request for Information form is incomplete or not used.

SC-10.11 Trade Names and Alternatives

SC-10.11 Add the following new paragraph immediately following Paragraph SC-10.10:

SC-10.11 Trade Names and Alternatives

The Owner has not made findings pursuant to Public Contract Code Section 3400(b) regarding the use of specific materials, products, things, and/or services that must be utilized for the Project.

ARTICLE 15 – PAYMENTS TO CONTRACTOR; SET-OFFS; COMPLETION; CORRECTION PERIOD

SC-15.03 Substantial Completion

SC 15.03.B Add the following new subparagraph to Paragraph 15.03.B:

1. If some or all of the Work has been determined not to be at a point of Substantial Completion and will require re-inspection or re-testing by Engineer, the cost of such re-inspection or re-testing, including the cost of time, travel and living expenses, shall be paid by Contractor to Owner. If Contractor does not pay, or the parties are unable to agree as to the amount owed, then Owner may impose a reasonable set-off against payments due under Article 15.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

SC-17.01 *Methods and Procedures*

SC-17.01 Paragraph 17.01 shall be deleted in its entirety and replaced with the following:

SC-17.01 Methods and Procedures

- A. All claims filed by the Contractor must be in writing and include the documents necessary to substantiate the claim. Notwithstanding any other provision herein, all claims that are equal to or less than Three Hundred Seventy-five Thousand Dollars (\$375,000) shall be resolved pursuant to Public Contract Code section 20104 et seq., as may be amended from time to time, and which provisions are incorporated herein. Claims must first be filed in accordance with the provisions of Sections B-7 and B-8 of these General Conditions. Under no circumstances, however, may a claim be filed after the day of final payment. Nothing in this subsection is intended to extend the time limit or supersede notice requirements for the filing of claims as set forth elsewhere in this contract.
1. **Claims Less Than \$50,000.00.**
 - a. The Owner will respond in writing to all written claims equal to or less than fifty thousand dollars (\$50,000) within forty-five (45) calendar days of receipt of the claim. Within thirty (30) calendar days of receipt of the claim, the Owner may request any additional documentation supporting the claim or relating to defenses or claims the Owner may have against the claimant.
 - b. If additional information is thereafter required, it shall be requested and provided pursuant to this subsection, upon mutual agreement of the Owner and the claimant.
 - c. The Owner's written response to the claim, as further documented, shall be submitted to the claimant within fifteen (15) calendar days after receipt of the further documentation or within a period of time no greater than that taken by the claimant in producing the additional information, whichever is greater.
 2. **Claims Between \$50,000.00 and \$375,000.00.**
 - a. The Owner will respond in writing to all written claims over fifty thousand dollars (\$50,000) and less than or equal to three hundred seventy-five thousand dollars (\$375,000), within sixty (60) calendar days of receipt of the claim. Within thirty (30) calendar days of receipt of the claim, the Owner may request, in writing, any additional documentation supporting the claim or relating to defenses to the claim the Owner may have against the claimant.

- b. If additional information is thereafter required, it shall be requested and provided pursuant to this Subdivision, upon mutual agreement of the Owner and the claimant.
 - c. The Owner's written response to the claim, as further documented, shall be submitted to the claimant within thirty (30) calendar days after receipt of the further documentation or within a period of time no greater than that taken by the claimant in producing the additional information or requested documents, whichever is greater.
- 3. **Claims in Excess of \$375,000.00.**
 - a. The Engineer shall, within a reasonable time after the presentation of any claim in excess of \$375,000, make a decision in writing on such claim.
 - b. All decisions of the Engineer shall be final unless the Contractor, within ten (10) calendar days after receipt of the Engineer's decision, files a written protest with the Engineer stating clearly and in detail the basis of the protest. Such protest shall be forwarded promptly by the Engineer to the City Council, who will issue a decision on such protest. It is hereby agreed that the Contractor's failure to protest the Engineer's determination or instruction within ten (10) calendar days after such determination or instruction is transmitted to the Contractor shall constitute a waiver by the Contractor of all rights to further protest, judicial or otherwise.
- 4. **Meet and Confer Conference.**
 - a. If the claimant disputes the Owner's written response, or the Owner fails to respond within the time prescribed, the claimant may so notify the Owner, in writing, either within fifteen (15) calendar days of receipt of the Owner's response or within fifteen (15) calendar days of the Owner's failure to respond within the time prescribed, respectively, and demand an informal conference to meet and confer for settlement of the issues in dispute. Upon a demand, the Owner shall schedule a meet and confer conference within thirty (30) calendar days for settlement of the dispute.
 - b. If, following the meet and confer conference, the claim or any portion thereof remains in dispute, the claimant may file a claim pursuant to Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code. For the purposes of those provisions, the running of the period of time within which a claim must be filed shall be tolled from the time the claimant submits his or her written claim pursuant to this Section until the time that claim is denied as a result of the meet and confer process, including any period of time utilized by the meet and confer process.

5. Contractor's Duty During Claim Resolution.

- a. The Contractor shall proceed with the work in accordance with the plans and specifications and determinations and instructions of the Engineer during the resolution of any claims disputes.

SC-17.02 Non-Binding Mediation

SC-17.02 Add the following new paragraph immediately after Paragraph 17.01.

SC-17.02 Non-Binding Mediation

- A. Within sixty (60) calendar days, but no earlier than thirty (30) calendar days, following the filing of responsive pleadings, the court shall submit the matter to non-binding mediation unless waived by mutual stipulation of both parties. The mediation process shall provide for the selection within fifteen (15) calendar days by both parties of a disinterested third person as mediator, shall be commenced within thirty (30) calendar days of the submittal, and shall be concluded within fifteen (15) calendar days from the commencement of the mediation unless a time requirement is extended upon a good cause showing to the court or by stipulation of both parties. If the parties fail to select a mediator within the fifteen (15) day period, any party may petition the court to appoint the mediator.

SC-17.03 Judicial Arbitration

SC-17.03 Add the following new paragraph immediately after Paragraph 17.02.

SC-17.03 Judicial Arbitration

- A. If the matter remains in dispute following mediation, the case shall be submitted to judicial arbitration pursuant to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, notwithstanding Section 1141.11 of that code. The Civil Discovery Act of 1986 (Article 3 (commencing with Section 2016) of Chapter 3 of Title 3 of Part 4 of the Code of Civil Procedure) shall apply to any proceeding brought under this subsection consistent with the rules pertaining to judicial arbitration.**
- B. Notwithstanding any other provision of law, upon stipulation of the parties, arbitrators appointed for purposes of this article shall be experienced in construction law, and, upon stipulation of the parties, mediators and arbitrators shall be paid necessary and reasonable hourly rates of pay not to exceed their customary rate, and such fees and expenses shall be paid equally by the parties, except in the case of arbitration where the arbitrator, for good cause, determines a different division. In no event shall these fees or expenses be paid by state or county funds.**
- C. In addition to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, any party who after receiving an arbitration award requests a trial de novo but does not obtain a more favorable judgment shall, in addition to payment of costs and fees under that chapter, pay the attorney's fees of the other party arising out of the trial de novo.**

SC-17.04 Payments by Owner

SC-17.04 Add the following new paragraph immediately after Paragraph 17.03.

SC-17.04 Payments by Owner

- A. The Owner shall pay money as to any portion of a claim which is undisputed except as otherwise provided in this contract.**
- B. In any suit filed under Paragraph SC-17.03, the Owner shall pay interest at the legal rate on any arbitration award or judgment. The interest shall begin to accrue on the date the suit is filed in a court of law.**

SC-17.05 Attorneys' Fees

SC-17.05 Add the following new paragraph immediately after Paragraph 17.02.

SC-17.03 Attorneys' Fees: For any matter subject to final resolution under this Article, the prevailing party shall be entitled to an award of its attorneys' fees incurred in the final resolution proceedings, in an equitable amount to be determined in the discretion of the court, arbitrator, arbitration panel, or other arbiter of the matter subject to final resolution, taking into account the parties' initial demand or defense positions in comparison with the final result.

ARTICLE 18 – MISCELLANEOUS

SC-18.09 Storage of Materials

SC-18.09 Add the following paragraph following Paragraph 18.08:

SC-18.09 Storage of Materials

Storage of materials on the job site must be approved by the RPR.

**APPENDIX A
PROPOSITION 84 GRANT REQUIREMENTS**

This project is funded in part by a grant administered by the California Department of Water Resources (DWR) under the Proposition 84 Grant Program. The City's Propositions 84 grant is disbursed through the regional grant received by the Association of Bay Area Governments (ABAG). The contractor is required to comply with all applicable requirements associated with Proposition 84 grants.

Appendix A.1 includes materials to be reviewed related to Proposition 84 grant requirements and forms that must be completed and submitted with the bid documents. Appendix A.2 includes supplemental special conditions associated with the Proposition 84 grant program. Appendix A.3 includes the anticipated terms and conditions of the City's grant with ABAG, of which certain conditions are applicable to the contractor

Enclosed please find:

APPENDIX A.1 – MATERIALS AND FORMS RELATED TO PROPOSITION 84 REQUIREMENTS

APPENDIX A.2 – SPECIAL SUPPLEMENTAL CONDITIONS RELATED TO PROPOSITION 84
REQUIREMENTS

APPENDIX A.3 – ANTICIPATED TERMS AND CONDITIONS OF THE CITY'S GRANT WITH
ABAG

APPENDIX A.1 – MATERIALS AND FORMS RELATED TO PROPOSITION 84 REQUIREMENTS

The bidder is required to review the information related to Proposition 84 grant requirements that is attached as part of this appendix section. The starred attachments indicate forms that must be completed and submitted the as part of the bid document.


- Attachment 1 Drug-Free Workplace Certification*
- Attachment 2 Nondiscrimination Certification*

DRUG-FREE WORKPLACE CERTIFICATION

STD. 21 (REV. 12-93)

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized legally to bind the contractor or grant recipient to the certification described below. I am fully aware that this certification, executed on the date below, is made under penalty of perjury under the laws of the State of California.

CONTRACTOR/BIDDER FIRM NAME	FEDERAL ID NUMBER
BY (Authorized Signature) 	DATE EXECUTED
PRINTED NAME AND TITLE OF PERSON SIGNING	TELEPHONE NUMBER (Include Area Code) ()
TITLE	
CONTRACTOR/BIDDER FIRM'S MAILING ADDRESS	

The contractor or grant recipient named above hereby certifies compliance with Government Code Section 8355 in matters relating to providing a drug-free workplace. The above named contractor or grant recipient will:

1. Publish a statement notifying employees that unlawful manufacture, distribution, dispensation, possession, or use of a controlled substance is prohibited and specifying actions to be taken against employees for violations, as required by Government Code Section 8355(a).
2. Establish a Drug-Free Awareness Program as required by Government Code Section 8355(b), to inform employees about all of the following:
 - (a) The dangers of drug abuse in the workplace,
 - (b) The person's or organization's policy of maintaining a drug-free workplace,
 - (c) Any available counseling, rehabilitation and employee assistance programs, and
 - (d) Penalties that may be imposed upon employees for drug abuse violations.
3. Provide as required by Government Code Section 8355(c), that every employee who works on the proposed contract or grant:
 - (a) Will receive a copy of the company's drug-free workplace policy statement, and
 - (b) Will agree to abide by the terms of the company's statement as a condition of employment on the contract or grant.
4. At the election of the contractor or grantee, from and after the "Date Executed" and until _____^(DATE) (NOT TO EXCEED 36 MONTHS), the state will regard this certificate as valid for all contracts or grants entered into between the contractor or grantee and this state agency without requiring the contractor or grantee to provide a new and individual certificate for each contract or grant. If the contractor or grantee elects to fill in the blank date, then the terms and conditions of this certificate shall have the same force, meaning, effect and enforceability as if a certificate were separately, specifically, and individually provided for each contract or grant between the contractor or grantee and this state agency.

ATTACHMENT A

**California Department of Public Health
Safe Drinking Water State Revolving Fund**

PROJECT INFORMATION

Water System Name: _____

Project Name: _____

Project Number: _____ - _____

Principal Contact: _____

Firm Name/ Contact/ Title

Firm Address/ Phone Number/ Email Address

NONDISCRIMINATION 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 OR
SUBCONTRACTOR NAME: _____

CERTIFIED BY:

NAME: _____ TITLE: _____

SIGNATURE: _____ DATE: _____

APPENDIX A.2 – SPECIAL SUPPLEMENTARY CONDITIONS RELATED TO PROPOSITION 84 REQUIREMENTS

SSC-A.01 ACKNOWLEDGEMENT OF CREDIT

Prior to the start of construction, the contractor shall place project sign(s) at a prominent location at the site, 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. The sign may need to be elevated and/or located close to City-designated areas for visibility. The contractor shall submit a prototype of the construction sign to the City for review and approval before posting the signs at the construction sites. A construction project sign template will be provided to the awarded contractor.

The sign shall be prepared in a professional manner, be at least four feet tall by eight feet wide, made of 3/4-inch thick exterior grade plywood or other approved material.

At a minimum, the following shall be included on the project signs:

- Project Title
- Purpose of Project
- Estimated Construction Duration
- Project Cost (if provided)
- Public Affairs contact
- City's color logo
- EPA's color logo
- City's Mission Statement

In addition to the above, the signs shall include other agencies logos, disclosure statements, or additional information as requested by the City, so long as the above requirements are equally prominent. The Contractor shall be responsible to maintain the signs in good condition for the duration of the project.

SSC-A.02 AMERICANS WITH DISABILITIES ACT

The contractor shall comply 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.

SSC-A.03 CHILD SUPPORT COMPLIANCE ACT

The contractor acknowledges in accordance with Public Contract Code §7110, that:

- a) The contractor 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 §5200) of Part 5 of Division 9 of the Family Code; and
- b) The contractor, 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.

SSC-A.04 CONFLICT OF INTEREST

The contractor is subject to State and Federal conflict of interest laws. Failure to comply with these laws, including business and financial disclosure provisions, will result in the application being rejected and any subsequent contract being declared void. Other legal action may also be taken. Applicable statutes include, but are not limited to, Government Code, §1090 and Public Contract Code, §10410 and §10411, for State conflict of interest requirements.

- 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 Employees:** 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.
- c) **Employees of the Contractor:** Employees of the contractor shall comply with all applicable provisions of law pertaining to conflicts of interest, including but not limited to any applicable conflict of interest provisions of the California Political Reform Act, Government Code §87100 et seq.
- d) **Employees and Consultants to the Contractor:** Individuals working on behalf of the contractor may be required by the Department to file a Statement of Economic Interests (Fair Political Practices Commission Form 700) if it is determined that an individual is a consultant for Political Reform Act purposes.

SSC-A.05 DRUG-FREE WORKPLACE CERTIFICATION

Certification of Compliance: By signing this proposal, the contractor hereby certifies, 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 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 §8355(a)(1).
- b) Establish a Drug-Free Awareness Program, as required by Government Code §8355(a)(2) to inform employees or subcontractors about all of the following:
 - i. The dangers of drug abuse in the workplace,
 - ii. Grantee's policy of maintaining a drug-free workplace,
 - iii. Any available counseling, rehabilitation, and employee assistance programs, and
 - iv. Penalties that may be imposed upon employees and subcontractors for drug abuse violations.

- c) Provide, as required by Government Code §8355(a)(3), that every employee and/or subcontractor who works under this project:
 - i. Will receive a copy of the contractor's drug-free policy statement, and
 - ii. Will agree to abide by terms of contractor's condition of employment, contract or subcontract.

SSC-A.06 CALIFORNIA LABOR CODE COMPLIANCE

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

SSC-A.07 NONDISCRIMINATION

During the performance of this project, the contractor and its subcontractors shall not unlawfully discriminate, harass, or allow harassment against any employee or applicant for employment because of sex (gender), sexual orientation, race, color, ancestry, religion, creed, national origin (including language use restriction), pregnancy, physical disability (including HIV and AIDS), mental disability, medical condition (cancer/genetic characteristics), age (over 40), marital status, and denial of medial and family care leave or pregnancy disability leave. The contractor and its subcontractors shall ensure that the evaluation and treatment of their employees and applicants for employment are free from such discrimination and harassment. The contractor and its subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Government Code §12990 (a-f) et seq.) and the applicable regulations promulgated there under (California Code of Regulations, Title 2, §7285 et seq.). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code §12990 (a-f), set forth in Chapter 5 of Division 4 of Title 2 of the California Code of Regulations, are incorporated into this Agreement by reference and made a part hereof as if set forth in full. The contractor and its subcontractors give written notice of their obligations under this clause to labor organizations with which they have a collective bargaining or other agreement.

The contractor shall include the nondiscrimination and compliance provisions of this clause in all subcontracts to perform work under this project.

SSC-A.08 NO DISCRIMINATION AGAINST DOMESTIC PARTNERS

For contracts over \$100,000 executed or amended after January 1, 2007, the contractor certifies under penalty of perjury under the laws of State of California that contractor is in compliance with Public Contract Code §10295.3 The requirements of this section prohibit state agencies from contracting with an entity that discriminates between employees with spouses and employees with domestic partners, or discriminates between employees with spouses or domestic partners of a different sex and employees with spouses or domestic partners of the same sex, or discriminates between same-sex and different-sex domestic partners of employees or between same-sex and different-sex spouses of employees.

SSC-A.09 TRAVEL COSTS

The contractor acknowledges that travel and per diem costs shall not be eligible for reimbursement. Travel includes the costs of transportation, subsistence, and other associated costs incurred by personnel.

SSC-A.010 WORKER'S COMPENSATION

The contractor affirms that it is aware of the provisions of §3700 of the Labor Code, which requires every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and the contractor affirms that it will comply with such provisions before commencing the performance of the work under this project and will make its subcontractors aware of this provision.

APPENDIX A.3 – TERMS AND CONDITIONS OF CITY’S PROPOSITION 84 GRANT

The contractor is required to comply with all applicable conditions of the City’s agreement with ABAG related to the Proposition 84 grant. Note that many of these conditions have been included in the special supplementary conditions listed in Appendix A.2.

For reference, the conditions included in the agreement between ABAG and DWR is included in the following pages. These conditions are anticipated to be included in the final agreement between ABAG and the City.

EXHIBIT D
STANDARD CONDITIONS**D.1) ACCOUNTING AND DEPOSIT OF FUNDING DISBURSEMENT:**

- a) **Separate Accounting of Funding Disbursements 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) **Disposition of Money Disbursed:** All money disbursed pursuant to this Grant Agreement shall be deposited, administered, and accounted for pursuant to the provisions of applicable law.
- d) **Remittance of Unexpended Funds:** Grantee shall remit to State any unexpended funds that were disbursed to Grantee under this Grant Agreement and were not used to pay Eligible Project Costs within a period of sixty (60) calendar days from the final disbursement from State to Grantee of funds or, within thirty (30) calendar days of the expiration of the Grant Agreement, whichever comes first.

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 Projects or using any data and/or information developed under this Grant Agreement. During construction of each 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) AIR OR WATER POLLUTION VIOLATION: Under State laws, the Grantee shall not be: (1) in violation of any order or resolution not subject to review promulgated by the State Air Resources Board or an air pollution control district; (2) subject to cease and desist order not subject to review issued pursuant to §13301 of the Water Code for violation of waste discharge requirements or discharge prohibitions; or (3) finally determined to be in violation of provisions of federal law relating to air or water pollution.

D.4) AMENDMENT: This Grant Agreement may be amended at any time by mutual agreement of the Parties, except insofar as any proposed amendments are in any way contrary to applicable law. Requests by the Grantee for amendments must be in writing stating the amendment request and the reason for the request. State shall have no obligation to agree to an amendment.

D.5) 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.6) APPROVAL: This Agreement is of no force or effect until signed by all parties to the agreement. Grantee may not submit invoices or receive payment until all required signatures have been obtained.

D.7) AUDITS: State reserves the right to conduct an audit at any time between the execution of this Grant Agreement and the completion of the Projects, with the costs of such audit borne by State. After completion of the Projects, State may require Grantee to conduct a final audit to State's specifications, 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 elect to pursue any remedies provided in Paragraph 14 or take any other action it deems necessary to protect its interests.

Pursuant to Government Code §8546.7, the Grantee shall be subject to the examination and audit by the State for a period of three years after final payment under this Grant Agreement with respect to all matters connected with this Grant Agreement, including but not limited to, the cost of administering this Grant Agreement. All records of Grantee or its contractor or subcontractors shall be preserved for this purpose for at least three (3) years after project completion or final billing, whichever comes later.

- D.8) BUDGET CONTINGENCY:** If the Budget Act of the current year covered under this Grant Agreement does not appropriate sufficient funds for the Proposition 84 Implementation Grant Program, this Grant Agreement shall be of no force and effect. This provision shall be construed as a condition precedent to the obligation of State to make any payments under this Grant Agreement. In this event, State shall have no liability to pay any funds whatsoever to Grantee or to furnish any other considerations under this Grant Agreement and Grantee shall not be obligated to perform any provisions of this Grant Agreement. Nothing in this Grant Agreement shall be construed to provide Grantee with a right of priority for payment over any other Grantee. If funding for any fiscal year after the current year covered by this Grant Agreement is reduced or deleted by the Budget Act for purposes of this program, State shall have the option to either cancel this Grant Agreement with no liability occurring to State, or offer a Grant Agreement amendment to Grantee to reflect the reduced amount.
- D.9) CALIFORNIA CONSERVATION CORPS:** As required in Water Code §79038(b), Grantee shall examine the feasibility of using the California Conservation Corps or community conservation corps to accomplish the habitat restoration, enhancement and protection activities listed in the Exhibit A, Work Plan, and shall use the services of one of these organizations whenever feasible.
- D.10) CEQA:** Activities funded under this Grant Agreement, regardless of funding source, must be in compliance with the California Environmental Quality Act (CEQA) (Public Resources Code §21000 et seq.). Information on CEQA may be found at the following links:
- Environmental Information: <http://resources.ca.gov/ceqa/>
- California State Clearinghouse Handbook:
https://www.opr.ca.gov/docs/SCH_Handbook_2012.pdf
- D.11) 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 §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.12) CLAIMS DISPUTE:** Any claim that the Grantee may have regarding performance of this agreement including, but not limited to, claims for additional compensation or extension of time, shall be submitted to the State's Project Manager, within thirty (30) calendar days of the Grantee's knowledge of the claim. State and Grantee shall then attempt to negotiate a resolution of such claim and process an amendment to this Agreement to implement the terms of any such resolution.
- D.13) 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.14) COMPUTER SOFTWARE:** 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.15) CONFLICT OF INTEREST:** All participants are subject to State and Federal conflict of interest laws. Failure to comply with these laws, including business and financial disclosure provisions, will result in the application being rejected and any subsequent contract being declared void. Other legal action may also be taken. Applicable statutes include, but are not limited to, Government Code, §1090 and Public Contract Code, §10410 and §10411, for State conflict of interest requirements.
- 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 Employees:** 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.
 - c) **Employees of the Grantee:** Employees of the Grantee shall comply with all applicable provisions of law pertaining to conflicts of interest, including but not limited to any applicable conflict of interest provisions of the California Political Reform Act, Government Code §87100 *et seq.*
 - d) **Employees and Consultants to the Grantee:** Individuals working on behalf of a Grantee may be required by the Department to file a Statement of Economic Interests (Fair Political Practices Commission Form 700) if it is determined that an individual is a consultant for Political Reform Act purposes.
- D.16) DELIVERY OF INFORMATION, REPORTS, AND DATA:** Grantee agrees to expeditiously provide throughout the term of this Grant Agreement, such reports, data, information, and certifications as may be reasonably required by State.
- D.17) DISPOSITION OF EQUIPMENT:** Grantee shall provide to State, not less than 30 calendar days prior to submission of the final invoice, an itemized inventory of equipment purchased with funds provided by State. The inventory shall include all items with a current estimated fair market value of more than \$5,000.00 per item. Within 60 calendar 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.18) 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 §8355(a)(1).

- b) Establish a Drug-Free Awareness Program, as required by Government Code §8355(a)(2) to inform employees, contractors, or subcontractors about all of the following:
 - i) The dangers of drug abuse in the workplace,
 - ii) Grantee's policy of maintaining a drug-free workplace,
 - iii) Any available counseling, rehabilitation, and employee assistance programs, and
 - iv) Penalties that may be imposed upon employees, contractors, and subcontractors for drug abuse violations.
- c) Provide, as required by Government Code §8355(a)(3), that every employee, contractor, and/or subcontractor who works under this Grant Agreement:
 - i) Will receive a copy of Grantee's drug-free policy statement, and
 - ii) Will agree to abide by terms of Grantee's condition of employment, contract or subcontract.

- D.19) FINAL INSPECTIONS AND CERTIFICATION OF REGISTERED PROFESSIONAL:** Upon completion of the Project, Grantee shall provide for a final inspection and certification by the appropriate registered professional (California Registered Civil Engineer or Geologist) 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. Grantee shall notify the State's Project Manager of the inspection date at least 14 calendar days prior to the inspection in order to provide State the opportunity to participate in the inspection.
- D.20) GRANTEE COMMITMENTS:** Grantee accepts and agrees to comply with all terms, provisions, conditions and commitments of this Grant Agreement, including all incorporated documents, and to fulfill all assurances, declarations, representations, and statements made by the Grantee in the application, documents, amendments, and communications filed in support of its request for funding.
- D.21) GRANTEE NAME CHANGE:** Approval of the State's Program Manager is required to change the Grantee's name as listed on this Grant Agreement. Upon receipt of legal documentation of the name change the State will process an amendment. Payment of invoices presented with a new name cannot be paid prior to approval of said amendment.
- D.22) GOVERNING LAW:** This Grant Agreement is governed by and shall be interpreted in accordance with the laws of the State of California.
- D.23) INDEMNIFICATION:** Grantee shall indemnify and hold and save the State, its officers, agents, and employees, free and harmless from any and all liabilities for any claims and damages (including inverse condemnation) that may arise out of the Projects and this Agreement, including, but not limited to any claims or damages arising from planning, design, construction, maintenance and/or operation of levee rehabilitation measures for this Project and any breach of this Agreement. Grantee shall require its contractors or subcontractors to name the State, its officers, agents and employees as additional insured on their liability insurance for activities undertaken pursuant to this Agreement.
- D.24) INDEPENDENT CAPACITY:** Grantee, and the agents and employees of Grantees, in the performance of the Grant Agreement, shall act in an independent capacity and not as officers, employees, or agents of the State.
- D.25) INSPECTION OF BOOKS, RECORDS, AND REPORTS:** During regular office hours, each of the parties hereto and their duly authorized representatives shall have the right to inspect and to make copies of any books, records, or reports of either party pertaining to this Grant Agreement or matters related hereto. Each of the parties hereto shall maintain and shall make available at all times for such inspection accurate records of all 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.26) INSPECTIONS OF PROJECT BY STATE:** State shall have the right to inspect the work being performed at any and all reasonable times during the term of the Grant Agreement. This right shall extend to any subcontracts, and Grantee shall include provisions ensuring such access in all its contracts or subcontracts entered into pursuant to its Grant Agreement with State.

- D.27) INVOICE 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 DWR Project Manager 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.28) LABOR CODE COMPLIANCE:** The Grantee will be required to keep informed of and take all measures necessary to ensure compliance with applicable Labor Code requirements, including, but not limited to, §1720 *et seq.*, of the Labor Code regarding public works, limitations on use of volunteer labor (Labor Code §1720.4), labor compliance programs (Labor Code §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 Labor Code §1771.3.
- D.29) NONDISCRIMINATION:** During the performance of this Grant Agreement, Grantee and its contractors or subcontractors shall not unlawfully discriminate, harass, or allow harassment against any employee or applicant for employment because of sex (gender), sexual orientation, race, color, ancestry, religion, creed, national origin (including language use restriction), pregnancy, physical disability (including HIV and AIDS), mental disability, medical condition (cancer/genetic characteristics), age (over 40), marital status, and denial of medial and family care leave or pregnancy disability leave. Grantee and its contractors or subcontractors shall ensure that the evaluation and treatment of their employees and applicants for employment are free from such discrimination and harassment. Grantee and its contractors or subcontractors shall comply with the provisions of the Fair Employment and Housing Act (Government Code §12990 (a-f) *et seq.*) and the applicable regulations promulgated there under (California Code of Regulations, Title 2, §7285 *et seq.*). The applicable regulations of the Fair Employment and Housing Commission implementing Government Code §12990 (a-f), set forth in Chapter 5 of Division 4 of Title 2 of the California Code of Regulations, are incorporated into this Agreement by reference and made a part hereof as if set forth in full. Grantee and its contractors or subcontractors 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 subcontracts to perform work under the Grant Agreement.
- D.30) NO DISCRIMINATION AGAINST DOMESTIC PARTNERS:** For contracts over \$100,000 executed or amended after January 1, 2007, the Grantee certifies by signing this Grant Agreement, under penalty of perjury under the laws of State of California that Grantee is in compliance with Public Contract Code §10295.3.
- D.31) OPINIONS AND DETERMINATIONS:** Where the terms of this Grant Agreement provide for action to be based upon, judgment, approval, review, or determination of either party hereto, such terms are not intended to be and shall never be construed as permitting such opinion, judgment, approval, review, or determination to be arbitrary, capricious, or unreasonable.
- D.32) PERFORMANCE AND ASSURANCES:** Grantee agrees to faithfully and expeditiously perform or cause to be performed all Project work as described in Exhibit A (Work Plan) and to apply State funds received only to Eligible Project Costs in accordance with applicable provisions of the law.
- D.33) PRIORITY HIRING CONSIDERATIONS:** If this Grant Agreement includes services in excess of \$200,000, the Grantee shall give priority consideration in filling vacancies in positions funded by the Grant Agreement to qualified recipients of aid under Welfare and Institutions Code §11200 in accordance with Public Contract Code §10353.
- D.34) PROHIBITION AGAINST DISPOSAL OF PROJECT WITHOUT STATE PERMISSION:** The Grantee 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

Projects, or with Grantee's service of water, without prior permission of State. Grantee shall not take any action, 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 be remitted to State.

- D.35) REMEDIES NOT EXCLUSIVE:** The use by either party of any remedy specified herein for the enforcement of this Grant Agreement is not exclusive and shall not deprive the party using such remedy of, or limit the application of, any other remedy provided by law.
- D.36) RETENTION:** Notwithstanding any other provision of this Grant Agreement, State shall, for each project, withhold five percent (5.0%) until January 1, 2018 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 19, "Submissions of Reports", 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. State shall disburse retained funds to the Grantee.
- D.37) RIGHTS IN DATA:** 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 made available to the State and shall be in the public domain to the extent to which release of such materials is required under the California Public Records Act., Government Code §6250 *et seq.* 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 State for financial support. 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. The State shall have the right to use any data described in this paragraph for any public purpose.
- D.38) SEVERABILITY:** Should any portion of this Grant Agreement be determined to be void or unenforceable, such shall be severed from the whole and the Grant Agreement shall continue as modified.
- D.39) STATE REVIEWS:** The parties agree that review or approval of projects applications, documents, permits, plans, and specifications or other project information by the State is for administrative purposes only and does not relieve the Grantee of their responsibility to properly plan, design, construct, operate, maintain, implement, or otherwise carry out the projects.
- D.40) SUSPENSION OF PAYMENTS:** This Grant Agreement may be subject to suspension of payments or termination, or both, and Grantee may be subject to debarment if the State determines that:
- a) Grantee, its contractors, or subcontractors have made a false certification, or
 - b) Grantee, its contractors, or subcontractors violates the certification by failing to carry out the requirements noted in this Grant Agreement.
- D.41) 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.42) TERMINATION BY GRANTEE:** Subject to State approval which may be reasonably withheld, Grantee may terminate this Agreement and be relieved of contractual obligations. In doing so, Grantee must provide a reason(s) for termination. Grantee must submit all progress reports summarizing accomplishments up until termination date.
- D.43) TERMINATION FOR CAUSE:** Subject to the right to cure under Paragraph 14, the State may terminate this Grant Agreement and be relieved of any payments should Grantee fail to perform the requirements of this Grant Agreement at the time and in the manner herein, provided including but not limited to reasons of default under Paragraph 14.

- D.44) TERMINATION WITHOUT CAUSE:** The State may terminate this Grant Agreement without cause on 30 calendar days advance written notice. The Grantee shall be reimbursed for all reasonable expenses incurred up to the date of termination.
- D.45) THIRD PARTY BENEFICIARIES:** 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 Agreement, or any duty, covenant, obligation or understanding established herein.
- D.46) TIMELINESS:** Time is of the essence in this Grant Agreement.
- D.47) 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.48) 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.
- D.49) WORKERS' COMPENSATION:** Grantee affirms that it is aware of the provisions of §3700 of the Labor Code, which requires every employer to be insured against liability for workers' compensation or to undertake self-insurance in accordance with the provisions of that code, and Grantee affirms that it will comply with such provisions before commencing the performance of the work under this Grant Agreement and will make its contractors and subcontractors aware of this provision.

Appendix B
County Stormwater Best Management Practices



SAN MATEO COUNTYWIDE

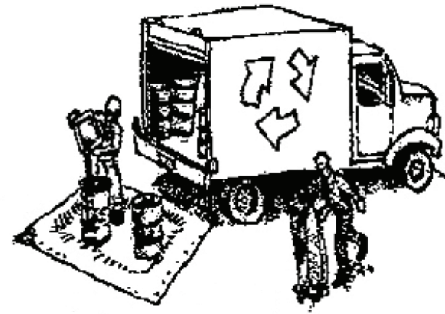
Water Pollution Prevention Program

Clean Water. Healthy Community.

Construction Best Management Practices (BMPs)

Construction projects are required to implement the stormwater best management practices (BMP) on this page, as they apply to your project, all year long.

Materials & Waste Management



Non-Hazardous Materials

- ❑ Berm and cover stockpiles of sand, dirt or other construction material with tarps when rain is forecast or if not actively being used within 14 days.
- ❑ Use (but don't overuse) reclaimed water for dust control.

Hazardous Materials

- ❑ Label all hazardous materials and hazardous wastes (such as pesticides, paints, thinners, solvents, fuel, oil, and antifreeze) in accordance with city, county, state and federal regulations.
- ❑ Store hazardous materials and wastes in water tight containers, store in appropriate secondary containment, and cover them at the end of every work day or during wet weather or when rain is forecast.
- ❑ Follow manufacturer's application instructions for hazardous materials and be careful not to use more than necessary. Do not apply chemicals outdoors when rain is forecast within 24 hours.
- ❑ Arrange for appropriate disposal of all hazardous wastes.

Waste Management

- ❑ Cover waste disposal containers securely with tarps at the end of every work day and during wet weather.
- ❑ Check waste disposal containers frequently for leaks and to make sure they are not overfilled. Never hose down a dumpster on the construction site.
- ❑ Clean or replace portable toilets, and inspect them frequently for leaks and spills.
- ❑ Dispose of all wastes and debris properly. Recycle materials and wastes that can be recycled (such as asphalt, concrete, aggregate base materials, wood, gyp board, pipe, etc.)
- ❑ Dispose of liquid residues from paints, thinners, solvents, glues, and cleaning fluids as hazardous waste.

Construction Entrances and Perimeter

- ❑ Establish and maintain effective perimeter controls and stabilize all construction entrances and exits to sufficiently control erosion and sediment discharges from site and tracking off site.
- ❑ Sweep or vacuum any street tracking immediately and secure sediment source to prevent further tracking. Never hose down streets to clean up tracking.

Equipment Management & Spill Control



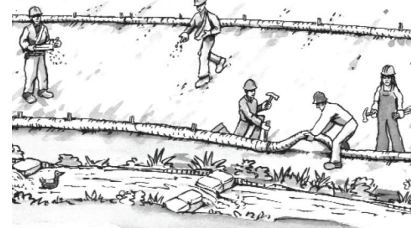
Maintenance and Parking

- ❑ Designate an area, fitted with appropriate BMPs, for vehicle and equipment parking and storage.
- ❑ Perform major maintenance, repair jobs, and vehicle and equipment washing off site.
- ❑ If refueling or vehicle maintenance must be done onsite, work in a bermed area away from storm drains and over a drip pan or drop cloths big enough to collect fluids. Recycle or dispose of fluids as hazardous waste.
- ❑ If vehicle or equipment cleaning must be done onsite, clean with water only in a bermed area that will not allow rinse water to run into gutters, streets, storm drains, or surface waters.
- ❑ Do not clean vehicle or equipment onsite using soaps, solvents, degreasers, or steam cleaning equipment.

Spill Prevention and Control

- ❑ Keep spill cleanup materials (e.g., rags, absorbents and cat litter) available at the construction site at all times.
- ❑ Inspect vehicles and equipment frequently for and repair leaks promptly. Use drip pans to catch leaks until repairs are made.
- ❑ Clean up spills or leaks immediately and dispose of cleanup materials properly.
- ❑ Do not hose down surfaces where fluids have spilled. Use dry cleanup methods (absorbent materials, cat litter, and/or rags).
- ❑ Sweep up spilled dry materials immediately. Do not try to wash them away with water, or bury them.
- ❑ Clean up spills on dirt areas by digging up and properly disposing of contaminated soil.
- ❑ Report significant spills immediately. You are required by law to report all significant releases of hazardous materials, including oil. To report a spill: 1) Dial 911 or your local emergency response number, 2) Call the Governor's Office of Emergency Services Warning Center, (800) 852-7550 (24 hours).

Earthmoving



- ❑ Schedule grading and excavation work during dry weather.
- ❑ Stabilize all denuded areas, install and maintain temporary erosion controls (such as erosion control fabric or bonded fiber matrix) until vegetation is established.
- ❑ Remove existing vegetation only when absolutely necessary, and seed or plant vegetation for erosion control on slopes or where construction is not immediately planned.
- ❑ Prevent sediment from migrating offsite and protect storm drain inlets, gutters, ditches, and drainage courses by installing and maintaining appropriate BMPs, such as fiber rolls, silt fences, sediment basins, gravel bags, berms, etc.
- ❑ Keep excavated soil on site and transfer it to dump trucks on site, not in the streets.

Contaminated Soils

- ❑ If any of the following conditions are observed, test for contamination and contact the Regional Water Quality Control Board:
 - Unusual soil conditions, discoloration, or odor.
 - Abandoned underground tanks.
 - Abandoned wells
 - Buried barrels, debris, or trash.

Paving/Asphalt Work



- ❑ Avoid paving and seal coating in wet weather or when rain is forecast, to prevent materials that have not cured from contacting stormwater runoff.
- ❑ Cover storm drain inlets and manholes when applying seal coat, tack coat, slurry seal, fog seal, etc.
- ❑ Collect and recycle or appropriately dispose of excess abrasive gravel or sand. Do NOT sweep or wash it into gutters.
- ❑ Do not use water to wash down fresh asphalt concrete pavement.

Sawcutting & Asphalt/Concrete Removal

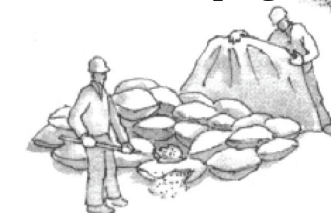
- ❑ Protect nearby storm drain inlets when saw cutting. Use filter fabric, catch basin inlet filters, or gravel bags to keep slurry out of the storm drain system.
- ❑ Shovel, absorb, or vacuum saw-cut slurry and dispose of all waste as soon as you are finished in one location or at the end of each work day (whichever is sooner!).
- ❑ If sawcut slurry enters a catch basin, clean it up immediately.

Concrete, Grout & Mortar Application



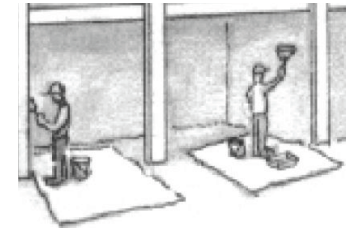
- ❑ Store concrete, grout, and mortar away from storm drains or waterways, and on pallets under cover to protect them from rain, runoff, and wind.
- ❑ Wash out concrete equipment/trucks offsite or in a designated washout area, where the water will flow into a temporary waste pit, and in a manner that will prevent leaching into the underlying soil or onto surrounding areas. Let concrete harden and dispose of as garbage.
- ❑ When washing exposed aggregate, prevent washwater from entering storm drains. Block any inlets and vacuum gutters, hose washwater onto dirt areas, or drain onto a bermed surface to be pumped and disposed of properly.

Landscaping



- ❑ Protect stockpiled landscaping materials from wind and rain by storing them under tarps all year-round.
- ❑ Stack bagged material on pallets and under cover.
- ❑ Discontinue application of any erodible landscape material within 2 days before a forecast rain event or during wet weather.

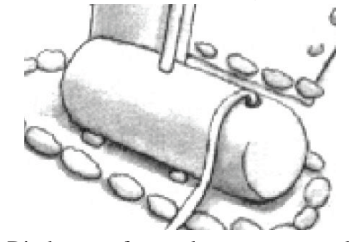
Painting & Paint Removal



Painting Cleanup and Removal

- ❑ Never clean brushes or rinse paint containers into a street, gutter, storm drain, or stream.
- ❑ For water-based paints, paint out brushes to the extent possible, and rinse into a drain that goes to the sanitary sewer. Never pour paint down a storm drain.
- ❑ For oil-based paints, paint out brushes to the extent possible and clean with thinner or solvent in a proper container. Filter and reuse thinners and solvents. Dispose of excess liquids as hazardous waste.
- ❑ Paint chips and dust from non-hazardous dry stripping and sand blasting may be swept up or collected in plastic drop cloths and disposed of as trash.
- ❑ Chemical paint stripping residue and chips and dust from marine paints or paints containing lead, mercury, or tributyltin must be disposed of as hazardous waste. Lead based paint removal requires a state-certified contractor.

Dewatering



- ❑ Discharges of groundwater or captured runoff from dewatering operations must be properly managed and disposed. When possible send dewatering discharge to landscaped area or sanitary sewer. If discharging to the sanitary sewer call your local wastewater treatment plant.
- ❑ Divert run-on water from offsite away from all disturbed areas.
- ❑ When dewatering, notify and obtain approval from the local municipality before discharging water to a street gutter or storm drain. Filtration or diversion through a basin, tank, or sediment trap may be required.
- ❑ In areas of known or suspected contamination, call your local agency to determine whether the ground water must be tested. Pumped groundwater may need to be collected and hauled off-site for treatment and proper disposal.

Storm drain polluters may be liable for fines of up to \$10,000 per day!

SECTION 01010

SUMMARY OF WORK AND CONTRACT CONSIDERATIONS

PART 1 – GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The project includes: well; well pump, well pad and pedestal; chlorine and ammonia chemical dosing; hydropneumatic tank; piping; site civil; electrical including Pacific Gas & Electric (PG&E) power and an emergency generator; ancillary facilities; and appurtenant civil, mechanical, structural, electrical, instrumentation and control improvements, all to make a complete and fully operable system as specified in the Contract Documents.. Piping will be designed to connect to the potable system and to facilitate future incorporation of iron and manganese treatment should the City choose to convert the well to an active supply source in the future.

1.02 TYPE OF CONTRACT

- A. The Work covered by these Contract Documents shall be provided under a single lump sum Contract.

1.03 WORK UNDER OTHER CONTRACTS

- A. Pacific Gas and Electric (PG&E) is planning on installing equipment and electric service to accommodate the site's new power requirements.
- B. Contractor shall be responsible for coordinating their work with PG&E's work.

1.04 OWNER-FURNISHED AND INSTALLED ITEMS (N.I.C. – NOT USED)

1.05 OWNER-FURNISHED CONTRACTOR INSTALLED ITEMS (O.F.C.I. – NOT USED)

1.06 ITEMS ORDERED IN ADVANCE (NOT USED)

1.07 PROVISIONS FOR FUTURE WORK (NOT USED)

1.08 WORK SEQUENCE

- A. See Specification 01020

1.09 EARLY PARTIAL OCCUPANCY AND USE BY OWNER (NOT USED)

1.10 CONTRACTOR'S USE OF SITE AND OWNERS CONTINUED OPERATIONS

- A. The Contractor shall confine his use of the site for work and storage to the Work Area Limits shown on the contract drawings. The Contractor's use of adjacent lands and roads for access to move onto and off of the site and for daily access of workers, material and equipment shall be arranged and scheduled to minimize

interference with the Owner's continued operations, as well as minimizing any disturbance to the adjacent residences.

- B. The Contractor shall comply with the Work Restrictions specified in Section 01020 in planning, scheduling, and completing the work.
- C. The Contractor shall be responsible for maintaining safe emergency exiting for the Owner's and Contractor's personnel in all areas affected by the Contractor's work.

1.11 DOCUMENTING EXISTING

- A. Prior to commencing the Work, tour the site with the Owner and the Engineer. Examine and document photographically and in writing the condition of existing buildings, equipment, improvements, and landscape planting on or adjacent to the site. This record shall serve as a basis for determination of subsequent damage due to the Contractor's operations and shall be signed by all parties making the tour. Record existing conditions on a DVD.

1.12 SHUTDOWN OF EXISTING UTILITIES, SERVICES OR OPERATIONS

- A. Obtain the Engineer's approval per Specification Section 01020 prior to the shutdown of any utility, service or operation of any existing facility. Give required notice and make appropriate arrangements with utility owners and other affected parties prior to shutdown of any utility service.
- B. Schedule utility service or operations shutdowns for periods of minimum use and at the Owner's convenience. Have all required material, equipment and workers on site prior to beginning any work involving a possible shutdown. Perform work as required to reduce shutdown time to the minimum. In some cases, this may require increased numbers of workers and/or premium time night or weekend work.
- C. The Contract Price shall include the cost of additional workers and premium time work required to minimize the impact of utility service or operations shutdowns when shutdowns are specified to be completed outside of normal working hours.

1.13 ALLOWANCES (NOT USED)

1.14 SCHEDULE OF VALUES

- A. Specific provisions are described in Article 2, paragraph 2.03 of the General Conditions.
- B. The Contractor's Schedule of Values shall be in a form acceptable to the Engineer and have at least the following level of detail: a separate line item for each technical specification section, for each work task with a value of greater than \$10,000, for site mobilization, for Construction Scheduling, for bonds and insurance, for final cleanup and demobilization, and for final deliverables. Subdivide final deliverables into: Record Drawings; Operation and Maintenance Manuals with Parts Lists; and Special Guarantees. Include the appropriate specification section and paragraph number for each line item. Subdivide major trades or portions of the work into

multiple line items that relate to observable milestones to aid monthly progress evaluations in accordance with the following example:

- Concrete Work
 - Foundations
 - Slab on grade
 - First floor walls and columns
 - Second floor beams and slabs
 - Second floor walls and columns, etc.

1.15 APPLICATION FOR PAYMENT

- A. Applications for Payment may be made only on General Conditions Application for Payment form in accordance with the General Conditions, Article 15. Line items on the Application for Payment shall be the same as those used on the Schedule of Values. Applications for Payment shall contain the Contractors Certification required by General Conditions, Article 15.

1.16 UNIT PRICE WORK

- A. When the Contract Documents include Unit Price Work, the Contract Price shall include an amount equal to the sum of Unit Prices bid for each item times the estimated quantity for that item listed on the Bid Form.
- B. The estimated quantities listed on the Bid Form are not guaranteed to be accurate but are intended solely to determine a Contract Price. If actual quantities differ from estimated quantities by more than plus or minus 25% the unit prices may be adjusted by negotiation. Payment to the Contractor shall be based on actual quantities for each type of work as determined by the Engineer from certified quantity surveys or measurements submitted by the Contractor.
- C. For the purpose of determining quantities for payment, the Contractor shall submit certified surveys by a licensed surveyor or other certified measurements of quantities to the Engineer with each application for payment. The Engineer will determine the quantities for payment based on data submitted by the Contractor and the Engineer's written determination shall be final unless appealed within 14 days under Article 13 of the General Conditions.
- D. Unit Prices shall include all of the Contractor's cost including overhead and profit.

1.17 CONTRACT MODIFICATIONS

- A. Methods of modifying the Contract Documents are covered in the General Conditions.
- B. The following documents may be used by the Engineer:
 - 1. Request for Quotation: Issued by the Engineer, a Request for Quotation is used to describe a proposed change and request a cost quotation from the Contractor but does not authorize a change in the Work or in the Contract Time or Price.

2. Change Order: Signed by the Engineer signifying its recommendation, and signed by the Contractor and Owner signifying their acceptance, a Change Order changes the Scope of Work and possibly the Contract Price and/or Contract Time.
3. Work Directive Change: Signed by the Owner (and in some cases by the Contractor) signifying their acceptance and issued by the Engineer, a Work Directive Change is used: (1) to direct the Contractor to do extra work on a cost accounting basis with a fixed maximum sum when the Owner and Contractor have not agreed on the price and time for the change, and (2) to direct the Contractor to do work that the Contractor contends is not included in the contract scope. Work done under case 1 will be converted to a Change Order when the Contractor and Owner agree on the change in price and time. The Contractor may make a claim under General Conditions for recovery of cost and time extension for work done under case 2; but if the claim is denied because the work is determined to be included in the contract scope, then the Contract Time and Price will not be changed. Work done under both cases 1 and 2 shall be done in accordance with the requirements for work done on a cost accounting basis described in the General Conditions.
4. Response to Request for Information: Issued by the Engineer, a Response to Request for Information is used to order or document minor changes in the work consistent with the intent of the Contract Documents and NOT involving a change in price or time. Information issued on a Response to Request for Information shall NOT authorize a change in Contract Price or Contract Time and shall not be considered a Constructive Change Order. If the Contractor considers that a Response to Request for Information would cause a change in Contract Price or Time, it shall notify the Engineer in writing within 15 days of receipt of the Response to Request for Information and shall not proceed with the work. See General Conditions.
5. The Contractor hereby expressly waives any claim or right to make a claim for an increase in contract time or price without written notice to the Engineer of the Contractor's intent to make a claim 5 days prior to proceeding to execute the work or portion thereof giving rise to such claim. See General Conditions.
6. The Contractor agrees that it shall not consider any Response to Request for Information, order, instruction, clarification, suggestion or any other communication either written or oral, given intentionally or unintentionally by the Engineer, Owner or any other person as authorization or direction to do any work that would cause a change in Contract Time or Price unless it is a formal written Change Order or Work Directive Change signed by the Owner.

1.18 REGULATORY REQUIREMENTS

- A. The codes and regulations together with local amendments when applicable adopted by the State and other governmental authorities having jurisdiction shall establish minimum requirements for this project. This project shall comply with the following:
 1. Uniform Building Code (UBC)
 2. Uniform Building Code Standards (UBCS)
 3. Uniform Fire Code (UFC)
 4. Uniform Mechanical Code (UMC)
 5. Uniform Plumbing Code (UPC)
 6. National Electric Code (NEC)

7. California Building Code
 8. California Code of Regulations
 - a. Title 8, Industrial Relations: Especially CAL-OSHA and Elevator Safety Orders.
 - b. Title 17, Public Health: Sections applicable to Food Service Facilities.
 - c. Title 19, Public Safety: Portions of the work regulated by the State Fire Marshal.
 - d. Title 24, Building Standards: Regulations applicable to Essential Service Facilities, Energy Conservation, Public Assembly and Handicapped Access.
- B. The latest edition of the requirements in effect at the date of submission of bids shall apply.
- C. General Conditions covers the Contractor's responsibility to comply with laws and codes applicable to Means and Methods for performing the Work.
- D. General Conditions covers the Contractor's responsibility to report code deficiencies in the design to the Engineer prior to proceeding with the Work.
- E. Paragraphs addressing Pre-Engineered Systems and Performance Specifications in other Sections cover the Contractor's responsibility to comply with code requirements when (1) performance specifications are used to describe all or portions of Work or items and (2) when pre-engineered (contractor designed) systems are specified.
- F. In cases where the Contract Documents are more restrictive than applicable codes, the Contractor shall comply with the Contract Documents.

1.19 REFERENCE STANDARDS

- A. When these specifications state that Work or tests shall conform to specific provisions in a referenced standard, specification, code, recommendation or manual published by an association, organization, society or agency the referenced provisions, as they apply to the Work of the Contractor only shall be considered a part of these specifications as fully as if included in total. When these specifications or applicable codes contain higher or more restrictive requirements than those contained in reference standards these specifications or applicable codes shall govern.
- B. The latest edition of a referenced standard published at the time of submission of bids shall apply unless a specific date for the referenced standard is cited in these specifications.
- C. General provisions in referenced standards, specifications, manuals or codes shall not change the specific duties and responsibilities between any of the parties involved in this work from those described in the General Conditions. Provisions in referenced standards with regard to measurement and payment shall not apply to this Work unless specifically cited. See General Conditions.

1.20 PROJECT SIGN

A. See Specification 01500.

1.21 SPECIFICATION LANGUAGE AND STYLE

- A. Many parts of the Specifications as well as notes on the Drawings are written in the active voice and are addressed to the Contractor.
1. When words or phrases requiring an action or performance of a task are used, it means that the Contractor shall provide the action or perform the task. For example: provide, perform, install, furnish, erect, connect, test, operate, adjust or similar words mean that the Contractor shall perform the action or task referred to.
 2. When words or phrases requiring selection, acceptance, approval, review, direction, designation or similar actions are referred to, it means that such actions are the Owner's or the Engineer's prerogative and that the Contractor must obtain such action before proceeding.
- B. Requirements in the Specifications and Drawings apply to all work of a similar type, kind or class even though the word "all" or "typical" may not be stated.

1.22 DEFINITIONS

- A. The following terms, when used in the Contract Documents, shall have the meanings listed:

ACCEPTABLE	"acceptable to the Engineer"
PERFORM	"perform all operations required to complete the work referred to in accordance with the intent of the Contract Documents"
PROVIDE	"furnish and install the work referred to including proper anchorage, connection to required utilities or other work, testing, adjustment and startup ready to put in service and perform the intended function"
REQUIRED	"required by the Contract Documents or required to complete the Work and produce the intended results"
SATISFACTORY	"acceptable to the Engineer"
SHOWN	"as indicated on the Drawings"
SITE	"geographical location of the Project and land within the work area shown on the contract drawings and within which the Work will be installed or built"
SPECIFIED	"as written in the Contract Documents including the Specifications and the Drawings"
SUBMIT	"submit to the Engineer"

1.23 ABBREVIATIONS

- A. The following acronyms or abbreviations are used in these specifications for the organizations listed.

<u>Abbreviation</u>	<u>Stands for</u>
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<u>Abbreviation</u>	<u>Stands for</u>
AASHTO	American Association of State Highway and Transportation Officials
AAMA	Architectural Aluminum Manufacturers Association
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
ADC	Air Diffusion Council
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standard Institute (formerly United States of America Standards Institute)
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
CAGI	Compressed Air and Gas Institute
CAL/OSHA	State of California Department of Industrial Relations, Division of Industrial Safety
CAL TRANS	California Department of Transportation
CBC	California Building Code
CBM	Certified Ballast Manufacturers
CBR	California Bearing Ratio
CI	Chlorine Institute
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CPSC	Consumer Products Safety Commission
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standards for the U.S. Department of Commerce
CTI	Cooling Tower Institute
DFPA	Douglas Fir Plywood Association
EIA	Electronic Industries Association
EPA	U.S. Environmental Protection Agency
ETL	Electronic Testing Laboratory
FM	Factory Mutual Insurance Company
FPS	Fluid Power Society
FS	Federal Specifications
GO 95	General Order No. 95, California Public Utilities Commission Rules

<u>Abbreviation</u>	<u>Stands for</u>
	for Overhead Electric Line Construction
GO 128	General Order No. 128, California Public Utilities Commission Rules for Underground Electrical Construction
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IGCC	Insulating Glass Certification Council
IPCE	International Power Cable Engineers Association
ISA	Instrument Society of America
NAAMM	National Association of Architectural Metal Manufacturers
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Act
PCA	Portland Cement Association
REA	Rural Electrification Administration
SAMA	Scientific Apparatus Makers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Structural Steel Painting Council
TCA	Tile Council of America
UBC	Uniform Building Code
UFC	Uniform Fire Code
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
USDC	U.S. Department of Commerce
UL	Underwriters Laboratories
WCLIB	West Coast Lumber Inspection Bureau
WIC	Woodwork Institute of California
WQCB	Water Quality Control Board (Regional)
WRCB	Water Resources Control Board

END OF SECTION

SECTION 01020

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions and coordination between construction operations and plant operations.
- B. The primary work restrictions are as follows:
 - 1. Shutdown of the existing potable water line to facilitate connections.
 - 2. Shutdown of the existing sanitary sewer to facilitate construction of a new lateral sewer to the main on Clarke Avenue.

1.02 GENERAL CONSTRAINTS ON SEQUENCE AND SCHEDULING OF WORK

- A. Conduct work in a manner that will not impair the operational capabilities of essential elements of the existing non-potable water pumping operation prior to commencing on-site construction.

1.03 INTERRUPTION OF POTABLE WATER AND SANITARY SEWER SERVICE

- A. Indicate required shutdowns of existing facilities on Progress Schedule. Submit requests for shutdowns to the Owner/Construction Manager for approval prior to each shutdown. Shutdowns will be permitted to the extent possible that existing operation of the potable water and sanitary sewer service will not be jeopardized and identified constraints are satisfied. No more than two shutdowns will be permitted per week. A minimum of two days between shutdowns will be required unless otherwise approved by OWNER.
- B. Do not begin alterations until OWNER's written permission has been received.
- C. Minimize shutdown times by thorough advanced planning. Have required equipment, materials, and labor on hand, ready for work, at time of shutdown.
- D. Where required to minimize service interruptions while complying with specified sequencing constraints, provide temporary pumping, plugs, power, lighting, controls, instrumentation, and safety devices.

1.04 COMPLIANCE WITH NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT AND OTHER FACILITY REGULATORY PERMITS

- A. The existing sanitary sewer is operating under the terms of a NPDES permit issued by the California Regional Water Quality Control Board San Francisco Bay Region. This permit specifies the water quality limits that the plant must meet prior to discharge of effluent. A copy of the existing permit is on file for review at the treatment plant.

- B. Perform work in a manner that will not prevent the existing facility from achieving the discharge water quality requirements established by regulations.
- C. Bear the cost of penalties imposed or scheduled on the OWNER by any regulatory agency for discharge violations caused by actions of the CONTRACTOR.
- D. Bypassing of untreated or partially treated sewage to surface waters or drainage courses is prohibited during construction. When such accidental bypassing occurs as a result of actions of the CONTRACTOR, the OWNER is entitled to take appropriate action and costs incurred will be deducted from progress payments.

1.05 SHUTDOWN CONSTRAINTS

- A. A shutdown is defined herein as that period of time during which adjacent residence access to either potable water or sanitary sewer service cannot take place.

1.06 UTILITIES

- A. Provide temporary utilities when necessary per Specification Section 01500.
- B. Provide advance notice to and utilize services of Underground Services Alert (U.S.A.) for location and marking of underground utilities operated by utility agencies other than the OWNER.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 COORDINATION OF WORK

- A. Maintain overall coordination of execution of work.
- B. Obtain construction schedules from subcontractors and suppliers and assume responsibility for correctness.
- C. Incorporate schedules from subcontractors and suppliers into Progress Schedule to plan for and comply with sequencing constraints.

3.02 WORK BY OTHERS

- A. Where proper execution of the Work depends upon work by others, in this case PG&E's replacement of the existing site transformer, inspect and promptly report discrepancies and defects.

3.03 GENERAL REQUIREMENTS FOR EXECUTION OF WORK

- A. Locate temporary facilities in a manner that minimizes interference to adjacent residences.

- B. Unless otherwise specified, install temporary pipelines of the same size as its connection to the existing facility at the downstream end of the pipeline.
- C. Provide piping of suitable material for the material being conveyed.
- D. Provide submittals on proposed temporary pumping facilities, temporary plugs, and temporary electrical and instrumentation components necessary to maintain existing facilities.
- E. Dimensions for all existing structures, piping, paving, and other nonstructural items are approximate. The CONTRACTOR shall field verify all dimensions and conditions and report any discrepancies to the ENGINEER a minimum of 14 days in advance of any construction in the area.
- F. Discrepancies between coordinates, bearings and lengths, and stationing shall be resolved in the following order of precedence:
 - 1. Coordinates.
 - 2. Bearings and lengths.
 - 3. Stationing.

3.04 WORK SEQUENCE AND CONSTRAINTS

- A. General:
 - 1. Refer to Specification Section 01010 for Contract Time requirements for each element listed herein and other elements on the project.
 - 2. The Suggested Work Sequence and Constraints presented herein do not necessarily include all items affecting the completion of the Work but are intended to describe in general the critical events necessary to construct the work. Utilize the description of critical events in the Work Sequence and Constraints in this Section as a guideline for scheduling and completing the Work. Additional Constraints may be imposed during the Work depending on CONTRACTOR's sequence of work.
 - 3. Any element not listed herein but requiring a shutdown shall have a maximum shutdown duration of 4 hours for planning purposes. Once these unforeseen shutdowns have been identified, confirm allowed shutdown durations with OWNER prior to starting the work.
 - 4. Unless noted otherwise or as determined by the ENGINEER, the term "Substantially Complete" referenced in this Section for any item shall be defined as when all structural, mechanical, electrical, instrumentation, and other incidental Work necessary to render that item of Work complete and ready for operation by the OWNER at the OWNER's discretion.
 - 5. Unless indicated otherwise, provide 14 days written notice, 3 days written confirmation, and a 24-hour final written notice to the OWNER and/or Construction Manager for review and acceptance prior to: (a) beginning demolition of each existing tank, structure, or equipment; (b) beginning each piping or channel tie-in to the existing treatment facility; (c) draining a tank or structure prior to beginning work adjacent to or inside that tank or structure:
 - a. The 3 days written confirmation shall be accompanied with a completed Shutdown Request Form (Attachment A) to be filled out by the CONTRACTOR.
 - b. The 24-hour final written notice shall also identify any major deviations, if any, to the Shutdown Request. Major deviations that cannot be

reasonably accommodated by OWNER may result in denial of the Shutdown Request, and any costs associated with delays that occur as a result of this denial shall be borne solely by the CONTRACTOR.

6. Critical events in the Work Sequence include, but are not limited to, the following:
 - a. Initial shutdown of the existing electrical service to the site
 - b. Coordination with PG&E's work to install new site transformer.
 - c. The CONTRACTOR shall submit their proposed Work Sequence and Plan to OWNER for favorable review prior to commencing any work.

END OF SECTION

SECTION 01040

COORDINATION AND PROJECT REQUIREMENTS

PART 1 – GENERAL

1.01 PROJECT COORDINATION

- A. Coordinate scheduling, submittals and work of various Sections of the Specifications and subcontractors to assure efficient and orderly sequence of interdependent construction. Provide accommodations for items to be furnished and installed by Owner and labeled "NIC" (not in contract) on the Drawings and for Owner Furnished Contractor Installed items.

1.02 MECHANICAL AND ELECTRICAL COORDINATION

- A. The Contractor's superintendent or a specially assigned assistant shall be designated the mechanical/electrical coordinator and shall coordinate the exact location, space priorities and sequence of installation of all mechanical and electrical work with each other and with all other trades. The mechanical/electrical coordinator shall assure compliance with the requirements of this paragraph 1.02.
- B. The location of mechanical and electrical work may be indicated diagrammatically on the Drawings. Actual locations shall follow locations shown on the Drawings as closely as practicable but shall be altered or adjusted in the field by the mechanical/electrical coordinator as required by the following:
 - 1. In finished spaces install mechanical and electrical work concealed within the space available.
 - 2. Organize mechanical and electrical work to make efficient use of space. Combine similar items into groups; make all runs parallel to or at right angles with building lines.
 - 3. Layout and install work to provide adequate space and access for adjustment, servicing, and maintenance and maximize space available for future installation of additional services or replacement of existing services.
 - 4. Assure that all access doors required by code or required for adjustment, servicing or maintenance are furnished to provide convenient access and to coordinate with finished visual elements.
 - 5. Coordinate location of fixtures, registers, grills, outlets, switches, panelboards, pullboxes, access doors, and other exposed mechanical and electrical items with functional and visual elements. Verify location of questionable items with Engineer before proceeding.
- C. Prepare large scale coordinated detailed installation drawings showing the work of all affected trades to coordinate the actual installed location of all equipment and of all mechanical and electrical work. Review coordination drawings with Engineer and all affected trades before proceeding.
- D. Review Shop Drawings and Product Data prior to submission for the Engineer's Review to assure that physical characteristics and service requirements are compatible with contract requirements, field conditions, and other items submitted.

- E. Verify that required services such as electrical power characteristics, control wiring, and utility requirements of items and equipment submitted and furnished are compatible with services provided. Notify Engineer of potential problems prior to ordering items or equipment and prior to installing services or completing construction in areas where services would have to be installed.
- F. Schedule installation sequence of various elements of mechanical and electrical work to achieve optimum compliance with requirements under Mechanical and Electrical Coordination in this Section.

1.03 CUTTING, FITTING, AND PATCHING

- A. Provide cutting, fitting, or patching required to complete the Work and to make all of its parts fit together properly. Include cutting, fitting, and patching required to:
 - 1. Fit the several parts together and to integrate with other work.
 - 2. Uncover work to install or correct ill-timed work.
 - 3. Provide openings in elements of work for penetrations of mechanical and electrical work.
 - 4. Remove and replace defective and non-conforming work.
 - 5. Remove samples of installed work for testing.
- B. Request guidance from the Engineer prior to beginning cutting or altering construction, which affects:
 - 1. Structural integrity of any element.
 - 2. Functional performance of any element.
 - 3. Integrity of weather-exposed or moisture-resistant elements.
 - 4. Efficiency, maintenance, or safety of elements.
 - 5. Visual qualities of sight-exposed elements.
 - 6. Work by Owner or separate contractor.
- C. Execute cutting and patching using workers that specialize in and are skilled in installing the type of work being cut or patched.
- D. Perform work in accordance with the Contract Documents or in the absence of specific requirements comply with best trade practice for the work involved.
 - 1. Execute work by methods that will avoid damage to other work.
 - 2. Provide proper support and substrates to receive patching and finishing materials.
 - 3. Cut concrete materials using masonry saw or core drill. Locate all reinforcing steel, conduits and pipes with electronic detecting devices prior to cutting or core drilling existing concrete.
 - 4. Replace or patch work with new materials meeting the requirements of these specifications or if not specified matching materials and finishes of existing or adjacent work.
 - 5. Cut wall, ceiling and floor finishes to fit snugly around pipes, sleeves, ducts, conduit, and other penetrations. Provide fire and/or acoustical caulking as required by code or conditions of use.
 - 6. Maintain integrity of wall, ceiling, or floor construction; completely seal voids against smoke, fire and water.
 - 7. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
 - 8. Report any hazardous or unsatisfactory conditions to the Engineer.

1.04 ALTERATION PROJECT PROCEDURES

- A. Plan, schedule and perform alteration work as required to minimize impacting the Owner's continued operations. See Section 01010 paragraph titled "Contractor's Use of Site and Owner's Continued Operations."
- B. Schedule utility interruptions, piping connections, and interruption of existing utility services as required to permit continued compliance with regulatory requirements and to meet Owners flow and processing requirements.
- C. Perform cutting fitting and patching in accordance with provisions in other paragraphs of this Section. Where new work abuts or aligns with existing work perform a smooth even transition. When a smooth unnoticeable transition is not feasible cut existing surfaces along a straight line at a natural dividing point and provide a groove or cover plate as recommended by the Engineer.
- D. Provide new construction in accordance with the technical specifications or if not specified provide new construction matching adjacent or similar existing work in material and finish.

1.05 CONNECTIONS TO UNDERGROUND UTILITIES, CONDUITS, OR PROCESS PIPING

- A. Obtain best available current information on location, identification and marking of existing utilities, piping and conduits and other underground facilities before beginning any excavation. In areas where utilities that participate in Underground Service Alert may occur, call 800-642-2444 in Northern California for information at least 48 hours in advance of beginning work. Give Engineer 24 hours notice before beginning work.
- B. The location of existing utilities and underground facilities known to the Design Engineer are shown in their approximate location based on information available at the time of preparing the Drawings. The actual location, size type and number of utilities and underground facilities may differ from that shown and utilities or underground facilities may be present that are not shown. See General Conditions for the Contractor's responsibilities and for differing conditions that warrant a change in Contract Price.
- C. Use extreme care when excavating or working in areas that may contain existing utilities, process piping, conduits or other underground facilities. Use careful potholing, hand digging and probing to determine the exact location of underground installation. Some locations contain multiple pipes or conduits. Prior to performing any subsurface work, investigate, determine and prepare a plan to turn off or disconnect each utility believed to be in the within 100 feet of the subsurface work in the event of an accidental breach of a utility conduit.
- D. Where connections to existing utilities or other underground facilities is required or where new piping or conduits may cross or interfere with existing utilities or underground facilities carefully excavate and uncover existing installations to a point 1 foot below the pipe or conduit to determine the actual elevation and alignment. Call the Engineer's attention to differing existing conditions that may require a clarification or change.

- E. Shutdown of existing utilities, services or operations shall be done in accordance with Section 01010.

1.06 FIELD ENGINEERING AND LAYOUT

- A. See General Conditions regarding reference points provided by Owner.
- B. General Conditions requires the Contractor to accurately layout the Work including the corners of buildings and other structures and the elevation of every floor, deck, roof, tank bottom, and channel.
- C. Employ a Surveyor to layout all detailed dimensions and elevations from reference points. Use recognized engineering survey methods and documentation techniques.

1.07 PRECONSTRUCTION MEETINGS

- A. Prior to beginning the Work, the Contractor and its key personnel and Subcontractors including the Contractor's Superintendent, Project Manager, and Field Engineer shall attend a meeting with the Owner and the Engineer to discuss the following:
 - 1. Name, Authority, and Responsibilities of Parties Involved
 - 2. Project Procedures:
 - a. Progress meetings
 - b. Correspondence
 - c. Notification
 - d. Submittal of Product Data, Shop Drawing Samples, and Proposed Equivalents
 - e. Requests for Information
 - f. Response to Requests for Information
 - g. Requests for Quotation
 - h. Work Directive Change
 - i. Change Orders
 - j. Engineer's "Items of Concern List"
 - 3. Temporary Schedule and Contractor's Construction Schedule
 - 4. Temporary Facilities and Control
 - 5. Testing During Construction
 - 6. Contractors Coordination
 - 7. Mechanical/Electrical Coordination
 - 8. Maintenance of Record Drawings
 - 9. Owner Provided Items or Work and Owner Furnished Contractor Installed items
 - 10. Early Beneficial or Partial Occupancy
 - 11. Final Testing, Startup, and Balancing
 - 12. Punch Lists and Project Closeout Procedures
 - 13. Final Deliverables including Record Drawings, Operation and Maintenance Manuals, and Special Guarantees.

1.08 PROGRESS MEETINGS

- A. The Engineer will conduct weekly or biweekly progress meetings with Contractor and Owner at job site. Attendance required by Contractor's project manager, superintendent and affected Subcontractors and suppliers. The Engineer will prepare, maintain and distribute agenda and dated record of: (1) actions required and taken and (2) decisions needed and made. Other meetings will be scheduled as needed by the Owner or Engineer.
- B. Agenda:
 - 1. Review critical items/action list.
 - 2. Review work progress. Compare actual progress with planned progress shown on Contractors rolling three-week Schedule. Discuss Corrective action required. Compare actual and projected progress with Contractor's Construction Schedule, propose methods to correct deficiencies.
 - 3. Review status of Submittals; review delivery dates and date of need for critical items.
 - 4. Review coordination problems.
 - 5. Schedule needed testing and critical inspections.
 - 6. Review critical requirements for each trade or major piece of equipment prior to beginning work or installation.
 - 7. Discuss Contractor Quality Control.
 - 8. Discuss open items on Engineers "Items of Concern List."
 - 9. Discuss impact of proposed changes on progress Schedule.
 - 10. Other business.

1.09 PERFORMANCE SPECIFICATIONS AND CONTRACTOR DESIGNED WORK

- A. Work under this Contract may be specified by a combination of descriptive, performance, reference standard and proprietary specifications. In the event of conflict between any of the various specification methods used to specify a single item the order of precedence shall be the order in which the methods are listed in the preceding sentence. The terms used to describe types of Specifications are taken from the Construction Specification Institute (CSI) Handbook of Practice.
- B. Where Specifications are used to define the characteristics of Contractor designed systems, items or components, the Contractor shall be fully responsible to design, engineer, manufacture, and install the systems, items and components to meet the specified functional requirements, performance requirements, quality standards, durability standards and conditions of use as well as all applicable codes, regulations and referenced trade or industry standards. The Contractor shall perform such design by employing engineers licensed in the State in which the Work is being constructed. The Contractor's design submittals shall include calculations and assumptions on which the design is based and shall be stamped and signed by appropriately licensed engineers.
- C. In accordance with General Conditions, the Owner and the Engineer shall have the right to rely on the expertise and professional competence of the Contractor's design. Favorable review of the Contractor's design submittal shall not relieve the Contractor from full responsibility for the adequacy of the Contractor design.

1.10 MATERIAL AND EQUIPMENT

A. General:

1. Verify that products delivered meet requirements of Contract Documents and the requirements for Favorably Reviewed submittals.

B. Compatibility of Equipment and Material:

1. Similar items, equipment, devices or products furnished under a single specification section shall all be made by the same maker and have interchangeable parts.
2. In addition, but only if so stated in each affected Specification Section, similar items furnished under two or more Specification Sections shall be made by the same maker and have interchangeable parts.
3. All similar materials or products that are interrelated or used together in an assembly shall be compatible with each other.

C. Transportation and Handling:

1. Transport and handle products in accordance with manufacturer's instructions.
2. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
3. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

D. Storage and Protection:

1. Store and protect products in accordance with manufacturer's instructions. Seals and labels shall be intact and legible.
2. Store moisture sensitive products including finish woodwork, gypsum products, acoustical products, motors, electrical equipment, instruments and controls in weathertight, humidity and temperature controlled enclosures.
3. For exterior storage of fabricated products, place items on sloped supports, aboveground.
4. Cover products subject to deterioration from moisture, dust, or sunlight with opaque watertight but breathable sheet covering. Provide ventilation to avoid condensation.
5. Provide offsite storage and protection including insurance coverage when site does not permit onsite storage or protection.
6. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
7. Provide facilities, equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
8. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

E. Installation Standards and Manufacturers' Recommendations:

1. Install all products and materials in strict compliance with the most restrictive of the following:
 - a. The manufacturer's or provider's written instructions or recommendations. Follow step-by-step installation procedures.
 - b. Recommendations of referenced trade associations or standards.
 - c. These specifications and drawings.

2. Where conflicts exist present alternatives with advantages and disadvantages to Engineer for decision.

F. If reference standards or manufacturer's instructions contain provisions that would alter or are at variance with relationships between the parties to the Contract set forth in the Contract Documents, the provisions in the Contract Documents shall take precedence. See General Conditions.

1.11 BACKING, SUPPORTS AND FASTENERS

A. Provide backing, supports, bracing, fasteners and other provisions required for the proper support and attachment of all work. Backing, supports, bracing and fasteners shall be sized to resist vertical and horizontal loads including seismic and wind loads required by codes listed under Regulatory Requirements in Section 01010 and in accordance with Seismic Design Requirements in this Section. Where finishes in existing facilities must be removed to install backing or where finishes are installed in new construction prior to installing backing the Contractor shall remove finishes, install backing and reinstall finishes.

1.12 NOT USED

1.13 SAFETY

A. In accordance with generally accepted construction practice, applicable law, the General Conditions, and Supplementary Conditions, the Contractor shall be solely and exclusively responsible for:

1. Construction means and methods.
2. Safety of employees engaged in the work while on and off the site.
3. Safety of the Owner, the Engineer, the Design Engineer, and others who may visit or be affected by the work.
4. Safety of the work itself including material and equipment to be incorporated therein.
5. Safety of other property at the site or adjacent thereto.
6. Safety programs, equipment and protective devices required to assure the safety of persons and property for whom/which the Contractor is responsible.
7. No smoking on the plant site.

B. The duties of the Engineer in conducting review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's work methods, equipment, bracing, scaffolding or safety measures in, on, or near the construction site. See General Conditions.

C. The Contractor is hereby informed that work on this project could be hazardous. The Contractor shall carefully instruct all personnel working in potentially hazardous work areas as to potential dangers and shall provide such necessary safety equipment and instructions as required to prevent injury to personnel and damage to property, and to comply with all applicable laws and regulations including State OSHA, Federal OSHA, and other regulations referenced in these Contract Documents.

D. The Contractor shall, at all times, maintain the job in a condition that is safe for the Owner, the Engineer and their Consultants to make site visits and to conduct construction reviews. If the Owner or the Engineer cannot allow personnel to visit

the job because it is not safe, the Contractor is not providing required safe access to the Work as required by General Conditions.

- E. The Contractor shall prepare a Safety Plan meeting the requirements of applicable regulations. As a minimum, the Contractor's Safety Plan shall set forth definite procedures for informing workers about safety, for instructing workers in safe practices, for assuring that workers are using appropriate safety equipment and safe work practices and for reporting accidents.

1.14 EXCAVATION AND TRENCHING; WORK WITHIN CONFINED SPACES

- A. Submit specific plans to the Owner showing details of provisions for worker protection from caving ground in accordance with Section 6705 of the California State Labor Code.

The detailed plans shall show the design of shoring, bracing, sloping banks or other provisions and shall be prepared, signed and stamped by a Civil or Structural Engineer licensed in the State in which the Work is performed and retained by the Contractor. The Owner's acceptance of the detailed plans submitted is only an acknowledgment of the submission and does not constitute review or approval of the designs, design assumptions, criteria, completeness, applicability to areas of intended use, or implementation of the plans, which are solely the responsibility of the Contractor and his Registered Engineer.

- B. Work Within Confined Spaces: Work within confined spaces is subject to applicable laws, regulations and safety orders including applicable California regulations.
- C. The foregoing provisions do NOT reduce the requirement for the Contractor to maintain safety in ALL operations performed by the Contractor or its Subcontractors.

1.15 CONTRACTOR'S QUALITY CONTROL

- A. The Contractor shall be fully responsible for inspecting the work of its suppliers and Subcontractors to assure that the work when completed will comply with the standards for materials and workmanship required by the Contract Documents. See General Conditions.
- B. Inspections, periodic observations and testing performed by the Owner or the Engineer are for the Owner's benefit and information only and shall not be construed as partial or incremental acceptance of the work and shall not be deemed to establish any duty on the part of the Owner or the Engineer to the Contractor, its subcontractors or suppliers. See General Conditions.
- C. The Contractor shall:
 1. Monitor quality control over suppliers, manufacturer, products, services, site conditions, and workmanship, to produce work of specified quality.
 2. Comply fully with manufacturer's installation instructions, including performing each step in sequence as recommended by the manufacturer.
 3. Submit a Request for Information to Engineer before proceeding with work when manufacturers' instructions or reference standards conflict with Contract Documents.
 4. Comply with specified standards as a minimum quality for the work except

when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

5. Perform work by persons specializing in the specific trade and class of work required and qualified to produce workmanship of specified quality.
6. Secure products in place with positive anchorage devices designed and sized to withstand seismic, static and dynamic loading, vibration, and physical distortion or disfigurement.

D. If reference standards or manufacturers' instructions contain provisions that would alter or are at variance with relationships between the parties to the Contract set forth in the Contract Documents, the provisions in the Contract Documents shall take precedence.

E. The Contractor shall provide assistance required by the Engineer to adequately inspect the Work including ladders, scaffolding, lighting, ventilation and other aids to facilitate access and provide a safe working environment.

1.16 TESTING LABORATORY SERVICES AND CERTIFIED LABORATORY REPORTS

A. Provide testing service in accordance with General Conditions and specific requirements contained in each technical specification section. Submit Certified Laboratory Reports required by technical specification sections.

B. Schedule of Required Testing and Certified Laboratory Reports. Note that structural-related specification sections, similar in vane to those listed below, will be provided by the Contractor who is responsible for developing the structural design for all Project components.

Specification Section	Item	Testing Service Retained and Paid for by Contractor
<i>03300, Cast-In-Place Concrete</i>	<i>Concrete Mix Design</i>	<i>Independent Testing Laboratory</i>
	<i>Reinforcing Steel and Portland Cement</i>	<i>Mill certificates or test reports by an independent testing laboratory if certificates are not available.</i>
	<i>Concrete Aggregate</i>	<i>Independent Testing Laboratory</i>
	<i>Concrete Batch Plant Inspection</i>	<i>Independent Testing Laboratory Batch Plant Inspection or Suppliers Laboratory Certified Statement of detailed compliance with ASTM C94 and paragraph 2.2</i>
	<i>Slump Tests</i>	<i>(by Engineer)</i>
	<i>Compression Tests</i>	<i>(Cylinders cast by Engineer) Cylinders cured at job site in a curing box provided by Contractor and meeting ASTM recommendations. Cylinders picked up at the jobsite and tested by independent Owner's testing laboratory.</i>
	<i>Testing of Concrete in place if required</i>	<i>Independent Testing Laboratory</i>
<i>05500, Metal Fabrications</i>	<i>Welders Qualifications</i>	<i>Submit ANSI/AWS D1.1 qualifying tests</i>
	<i>Test Weld by Each Welder</i>	<i>Witnessed by ENGINEER and tested by an independent testing laboratory.</i>

Specification Section	Item	Testing Service Retained and Paid for by Contractor
	<i>Steel Material and Fasteners</i>	<i>Mill laboratory certificates for steel from each melt used. If mill certificates are unavailable or if steel from an unidentified melt is used, submit test report from an independent testing laboratory.</i>
	<i>Welding Inspection</i>	<i>Independent Testing Laboratory shall continuously inspect multiple pass welds and inspect single pass welds on completion.</i>
	<i>Full Penetration Welds in Moment Resisting Joints</i>	<i>Independent Testing Laboratory shall ultrasonically test 100% of joints</i>
	<i>High Strength Bolted Connections</i>	<i>Independent Testing Laboratory shall inspect all high strength bolted connections.</i>

Note 1: Unless indicated in parentheses as “By Engineer”, all testing services shall be retained and paid for by the Contractor.

END OF SECTION

SECTION 01090

REGULATORY REQUIREMENTS AND PERMITS

1.1 APPLICABLE CODES

- A. See Section 01010, Summary of Work and Contract Considerations, and the Technical Specifications for applicable codes.

1.2 FEES AND PERMITS

- A. Contractor shall comply with all the terms, conditions and requirements attached to all permits, bonds and licenses required by any local, state, or federal agencies to perform work, construct, erect, test and start up of any equipment or facility for this Contract. The Contractor shall give all notices necessary and incidental to the due and lawful prosecution of the Work.
- B. Any permits, bonds, licenses and fees therefore required for the performance of work under this Contract and not specifically mentioned herein as being obtained and paid for by the Owner shall be included in the Contractor's bid price. The Contractor shall apply for and obtain all safety permits for excavations, tunneling, trenches, construction (building structure, scaffolding, or falsework) and demolition required by CAL/OSHA.
- C. The Contractor shall post at the site of Work all required permits as stipulated by the respective regulatory agency.
- D. Contractor shall be responsible to secure, in writing, permission of adjacent property owners for use of or entry onto said lands in a form agreeable to the property owner. Submit documentation of said owner's approval to the Engineer.
- E. Local Agency and Building Code Fees and Permits
 - 1. If applicable to any portions of the Work, the Owner has applied for and obtained, in its name, the necessary building permit for this project. The Contractor shall be responsible for satisfying all code requirements, calling for inspections, and obtaining final approvals on behalf of the Owner. The Contractor shall notify the Engineer of the need and the readiness of all required inspections. All inspections are to be coordinated with the Engineer. The Contractor shall comply with all construction conditions stipulated in the permits. The Contractor shall be responsible for and the Owner shall not provide reimbursement for any costs required for the reinspection of defective work or additional costs due to the Contractor's failure to properly schedule the inspections. The Contractor shall comply with the provisions of any and all permits contained in the Appendices to these Specifications.
 - 2. The Owner is not responsible for any local agency or utility permits required for temporary facilities during construction such as field office trailers and temporary electrical service for construction operations. Obtaining all such

permits and the costs associated with such permits are the responsibility of the Contractor and shall be included in the Contractor's bid price.

F. Environmental Restrictions

1. In addition to the requirements in the summary of permits, the Contractor shall provide environmental protection in accordance with the County requirements. The Contractor shall coordinate its work relating to these requirements with the Engineer.

1.3 SUMMARY OF PERMITS

- A. Contractor shall procure all required work permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work.

1.4 STORM WATER QUALITY CONTROLS

A. Contractor's Responsibilities

1. The Contractor shall comply with the SWRCB, RWQCB, and County requirements regarding stormwater management, inspection, monitoring.
2. The Contractor shall submit an erosion control plan in accordance with the County requirements.

1.5 DEWATERING

- A. Construction dewatering is regulated by the appropriate California Regional Water Quality Control Board. Should the Contractor need to control groundwater by dewatering and/or depressurization of water bearing soil and rock formations, the Contractor must comply with all laws and regulations having jurisdiction over construction dewatering. The Contractor is responsible for obtaining all permits from agencies with control over all dewatering matters. The Contractor will be held responsible for any fines or penalties from regulatory agencies resulting from its dewatering system.
- B. 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.

END OF SECTION

SECTION 01140

ENVIRONMENTAL PROTECTION [WILL BE UPDATED TO REFLECT CEQA WORK]

1.01 SCOPE

- A. During the progress of the work, keep the work areas occupied by the Contractor in a neat and clean condition and protect the environment both onsite and offsite, throughout and upon completion of the construction project.
- B. Comply with the mitigation measures specified herein.

1.02 SUBMITTALS

- A. Develop an Environmental Protection Plan in detail and submit to the Engineer in the Product Review category within thirty (30) days from the date of the Notice to Proceed. Distribute the favorably reviewed plan to all employees and to all subcontractors and their employees. The Environmental Protection Plan shall include, but not be limited to, the following items:
 - 1. Copies of required permits.
 - 2. Proposed sanitary landfill site.
 - 3. Other proposed disposal sites.
 - 4. Copies of any agreements with public or private landowners regarding equipment, materials storage, borrow sites, fill sites, or disposal sites. Any such agreement made by the Contractor shall be invalid if its execution causes violation of local or regional grading or land use regulations.
 - 5. Water pollution control plan.

1.03 MITIGATION OF CONSTRUCTION IMPACTS

- A. Requirements: All operations shall comply with all federal, state and local regulations pertaining to water, air, solid waste and noise pollution.
- B. Definitions of Contaminants:
 - 1. Sediment: Soil and other debris that have been eroded and transported by runoff water.
 - 2. Solid Waste: Rubbish, debris, garbage and other discarded solid materials resulting from construction activities, including a variety of combustible and non-combustible wastes, such as ashes, waste materials that result from construction or maintenance and repair work, leaves and tree trimmings.
 - 3. Chemical Waste: Includes petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, disinfectants, organic chemicals and inorganic wastes. Some of the above may be classified as "hazardous."
 - 4. Sanitary Wastes:
 - a. Sewage: That which is considered as domestic sanitary sewage.
 - b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing and consumption of food.
 - 5. Hazardous Materials: As defined by applicable laws and regulations. Undisclosed hazardous material contamination, if encountered will constitute a

changed site condition. The Owner may retain a separate contractor to dispose of undisclosed hazardous material encountered.

C. Aesthetics

1. Contractor shall maintain the project site in a clean and orderly fashion, including cleaning up the site at the end of each work day, removing trash and construction debris at regular intervals, stockpiling materials neatly, and organizing equipment and material storage areas. To the extent feasible, construction equipment and materials shall be stored away from public views.

D. Protection of Natural Resources:

1. General: It is intended that the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract be preserved in their existing condition or be restored to an equivalent or improved condition upon completion of the work. Confine construction activities to areas defined by the public roads, easements, and work area limits shown on the Drawings. Return construction areas to their pre-construction elevations except where surface elevations are otherwise noted to be changed. Maintain natural drainage patterns. Conduct construction activities to avoid ponding stagnant water conducive to mosquito breeding.
2. Land Resources: Do not remove, cut, deface, injure or destroy trees or shrubs outside the work area limits. Do not remove, deface, injure or destroy trees within the work area without permission from the Engineer.
 - a. Protection: Protect trees that are located near the limits of the Contractor's work areas which may possibly be defaced, bruised or injured or otherwise damaged by the Contractor's operations. No ropes, cables or guys shall be fastened to or attached to any existing nearby trees or shrubs for anchorages unless specifically authorized. Where such special emergency use is permitted, the Contractor shall be responsible for any damage resulting from such use.
 - b. Trimming: Trim and seal tree limbs overhanging the line of the work and in danger of being damaged by the Contractor's operations in accordance with recognized standards for such work. Remove other tree limbs under the direction of the Engineer, so that the tree will present a balanced appearance.
 - c. Treatment of Roots: Do not cut roots unnecessarily during excavating or trenching operations. Expose major roots encountered in the course of excavation and do not sever. Wrap them in burlap as a protective measure while exposed. Neatly trim all other roots larger than 1 inch in diameter that are severed in the course of excavation at the edge of the excavation or trench and paint them with a heavy coat of an approved tree seal.
 - d. Repair or Restoration: Repair or replace any trees or other landscape features scarred or damaged by equipment or construction operations as specified below. The repair and/or restoration plan shall be favorably reviewed prior to its initiation.
 - e. Temporary Construction: Obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction as directed by the Engineer. Level all temporary roads, parking areas and any other areas that have become compacted or

- shaped. Any unpaved areas where vehicles are operated shall receive a suitable surface treatment or shall be periodically wetted down to prevent construction operations from producing dust damage and nuisance to persons and property, at no additional cost to the Owner. Keep haul roads clear at all times of any object that creates an unsafe condition. Promptly remove any contaminants or construction material dropped from construction vehicles. Do not drop mud and debris from construction equipment on public streets. Sweep clean turning areas and pavement entrances as necessary.
3. Water Resources: Investigate and comply with all applicable federal, state and local regulations concerning the discharge (directly or indirectly) of pollutants to the underground and natural waters. Perform all work under this Contract in such a manner that any adverse environmental impacts are reduced to a level that is acceptable to the Engineer and regulatory agencies. Refer to the paragraph on control of water in Section 02301 Earthwork, for "dewatering" water disposal requirements.
 - a. Oily Substances: At all times, special measures shall be taken to prevent oily or other hazardous substances from entering the ground, drainage areas or local bodies of water in such quantities as to affect normal use, aesthetics or produce a measurable impact upon the area. Any soil or water that is contaminated with oily substances due to the Contractor's operations shall be disposed of in accordance with applicable regulations.
 - b. Chlorinated Water: Take special measures to prevent chlorinated water from entering the ground or surface waters. Dechlorinate chlorinated water prior to discharge.
 4. Fish and Wildlife Resources: Perform all work and take such steps required to prevent any interference or disturbance to fish and wildlife. The Contractor will not be permitted to alter water flows or otherwise significantly disturb native habitat adjacent to the project area which are critical to fish and wildlife except as may be indicated or specified.
 5. Cultural Resources: The project does not pass through any known archaeological sites. However, it is conceivable that unrecorded archaeological sites could be discovered during the construction. In the event that artifacts, human remains, or other cultural resources are discovered during excavations at locations of the Work, the Contractor shall protect the discovered items, notify the Engineer, and comply with applicable law.
 6. Revegetation of Disturbed Areas:
 - a. Tree and Shrubs Replacement: Replace trees and shrubs damaged by the construction or as noted on the Drawings after completion of earthwork in the area. Plant nursery stock of the same species and variety, in 5-gallon cans on a one-for-one basis. Plant in the early fall. If planting is not feasible in early fall, the Engineer will reschedule the tree planting operations.
 - b. Planting of Trees and Shrubs:
 - 1) Selection: Deliver trees and shrubs to the site in the nursery containers, with the nursery tags identifying the species and variety. The trees and shrubs should be selected for shape and symmetrical branching habit, which at maturity will produce strong, full foliated specimens. The specimens shall have grown in the designated size of container for a sufficient length of time for the root system to hold the earth when taken from the container, but not long enough to become rootbound or cause a "hardening off" of the root system. Specimens

which are loose in the root ball will be rejected. Remove all rejected specimens from the site and replace with specimens as specified. Specimens shall be sound, healthy, vigorous and free from insects, pests, plant diseases and injuries.

- 2) Protection: Specimens which cannot be planted within one day of delivery shall be properly protected and kept moist to prevent drying.
 - 3) Planting Procedure: Planting hole shall be twice the width of the root ball and at least one and one-half times the height of the root ball. Fill the planting hole with water and let drain away. Mix excavated soil with a planting mix appropriate for the type and condition of the soil and the species of tree or shrub and place the mixed soil in the planting hole to the depth necessary to bring the root ball slightly higher than the surrounding soil. Remove the specimen from the container carefully so that the root ball remains unbroken. Place in planting hole and fill with mixed soil to one-half the height of the root ball, tamp thoroughly, then water. Set specimens at such a level that after settlement the top of the root ball is level with the surrounding finish grade. Add mixed soil to form watering basin, fill basin twice with water immediately after planting. Water as frequently as required to keep the specimens adequately moist until well established. The Contractor will be responsible for maintaining specimens for a minimum of one year after final acceptance or planting, whichever is later.
 - 4) Staking: Use 2-inch x 2-inch redwood or cedar stakes of length adequate to support each tree. Drive a stake on each side of each specimen outside of the root ball, to a depth of 3 feet. Support tree to stakes using twisted galvanized wire covered with reinforced rubber hose where in contact with the specimen.
 - 5) Mulching: Fill all watering basins of trees and shrubs with a layer of mulch not less than 2 inches thick.
7. Noise Control: The following noise control procedures shall be employed:
- a. Maximum Noise Levels within 1,000 Feet of any Residence, Business, or Other Populated Area: Noise levels for trenchers, pavers, graders and trucks shall not exceed 90 dBA at 50 feet as measured under the noisiest operating conditions. For all other equipment, noise levels shall not exceed 85 dBA at 50 feet.
 - b. Equipment: Jack hammers shall be equipped with exhaust mufflers and steel muffling sleeves. Air compressors should be of a quiet type such as a "whisperized" compressor.
 - c. Operations: Keep noisy equipment as far as possible from noise-sensitive site boundaries. Machines should not be left idling. Use electric power in lieu of internal combustion engine power wherever possible. Maintain equipment properly to reduce noise from excessive vibration, faulty mufflers, or other sources. All engines shall have mufflers.
 - d. Scheduling: Schedule noisy operations so as to minimize their duration at any given location.
 - e. Monitoring: To determine whether the above noise limits are being met and whether noise barriers are needed, the Contractor shall use a portable sound level meter meeting the requirements of American National Standards Institute Specification S1.4 for Type 2 sound level meters. If non-complying noise levels are found, the Contractor shall be responsible for monitoring and correction of excessive noise levels.

8. Dust Control, Air Pollution and Odor Control: Contractor shall employ measures to prevent the creation of dust, air pollution and odors.
 - a. Water all active construction areas at least twice daily.
 - b. Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain at least two feet of freeboard.
 - c. Pave, apply water three times daily, or as needed to sufficiently reduce dust emissions, or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites.
 - d. Sweep daily (with water sweepers) all paved access roads, parking areas, and staging areas at construction sites.
 - e. Sweep streets daily (with water sweepers) if visible soil material is carried onto adjacent public streets.
 - f. Suspend excavation and grading activity when winds (instantaneous gusts) exceed 25 mph.
 - g. Limit the area subject to excavation, grading and other construction activity at any one time.
9. Construction Storage Areas: Storage of construction equipment and materials shall be limited to the designated Contractor's storage area.
 - a. Store and service equipment at the designated Contractor's storage area where oil wastes shall be collected in containers. Oil wastes shall not be allowed to flow onto the ground or into surface waters. Containers shall be required at the construction site for the disposal of materials such as paint, paint thinner, solvents, motor oil, fuels, resins and other environmentally deleterious substances. No dumping of surplus concrete or grout on the site will be permitted.
10. Sanitation: During the construction period, provide adequate and conveniently located chemical sanitation facilities, properly screened, for use of construction crews, and visitors to the site. Facilities shall be regularly maintained.
11. Fire Prevention: Take steps to prevent fires including, but not limited to the following:
 - a. Provide spark arrestors on all internal combustion engines.
 - b. Store and handle flammable liquids in accordance with the Flammable and Combustible Liquids Code, NFPA 30.
 - c. Provide fire extinguishers at hazardous locations or operations, such as welding.
12. Erosion and Sediment Transport Control: Prepare a SWPPP that identifies pollutant sources that could affect the quality of stormwater discharges from the construction site. Include control practices that effectively target pollutants in stormwater discharges and comply with the requirements of the revised California Construction Stormwater Permit when it becomes effective in 1 July 2010. To protect receiving water quality, the SWPPP shall include, but is not limited to, the following elements:
 - a. Discharge construction runoff into small drainages at frequent intervals to avoid buildup of large potentially erosive flows.

- b. Prevent runoff from flowing over unprotected slopes.
- c. Keep disturbed areas to the minimum necessary for construction.
- d. Keep runoff away from disturbed areas during construction.
- e. Direct flows over vegetated areas prior to discharge into public storm drainage systems.
- f. Trap sediment before it leaves the site, using such techniques as check dams, sediment ponds, or siltation fences.
- g. Remove and dispose of all project construction-generated siltation that occurs in offsite retention ponds.
- h. Stabilize disturbed areas as quickly as possible.

1.04 DISPOSAL OPERATIONS

- A. Solid Waste Management:
 - 1. Supply solid waste transfer containers. Daily remove all debris such as spent air filters, oil cartridges, cans, bottles, combustibles and litter. Take care to prevent trash and papers from blowing onto adjacent property. Encourage personnel to use refuse containers. Convey contents to a sanitary landfill.
 - 2. Washing of concrete containers where wastewater may reach adjacent property or natural water courses will not be permitted. Remove any excess concrete to the sanitary landfill.
- B. Chemical Waste and Hazardous Materials Management: Furnish containers for storage of spent chemicals used during construction operations. Dispose of chemicals and hazardous materials in accordance with applicable regulations.
- C. Garbage: Store garbage in covered containers, pick up daily and dispose of in a sanitary landfill.
- D. Dispose of vegetation, weeds, rubble, and other materials removed by the clearing, stripping and grubbing operations off site at a suitable disposal site in accordance with applicable regulations.
- E. Excavated Materials:
 - 1. Native soil complying with the requirements of Section 02301, Earthwork, may be used for backfill, fill and embankments as allowed by that section.
 - 2. Spoil Material:
 - a. Remove all material which is excavated in excess of that required for backfill, and such excavated material which is unsuitable for backfill, from the site and dispose of off site in accordance with applicable regulations at the disposal site indicated in the Environmental Protection Plan. No additional compensation will be paid to the Contractor for such disposal. Include all such costs in the lump sum prices bid for the project.
 - b. Rubbish shall consist of all materials not classified as suitable materials or rubble and shall include shrubbery, trees, timber, trash and garbage.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 – GENERAL

1.01 SUBMITTAL PROCEDURES

- A. All submittals shall be provided in electronic format, except as noted otherwise.
- B. Accompany each submittal with a Submittal form, which contains the following information:
 - 1. Contractor's name and the name of Subcontractor or supplier who prepared the submittal.
 - 2. The project name and identifying number.
 - 3. Description of the submittal and reference to the Contract requirement or technical specification section and paragraph number being addressed.
- C. Submit the number and type of copies for each submittal and follow the procedures described below or in other paragraphs in this Section. Submit four copies of submittals not covered in this Section 01300.
 - 1. Designation of Superintendent: Submit three copies for information. Include name, address, home telephone number and a brief resume.
 - 2. List of Subcontractors and Major Suppliers: Submit three copies for information. Include address, telephone number and name of responsible party.
 - 3. Schedule of Values, in a form acceptable to the Engineer: Submit three copies for information. No copy will be returned. See General Conditions.
 - 4. Subcontractors'/Suppliers'/Manufacturers' Affidavits. Submit three copies for items specified in the Technical Specifications.
 - 5. Environmental Protection Plan. Submit three copies for information.

1.02 SCHEDULE OF SUBMITTALS

- A. See General Conditions. Within 15 days after the Notice to Proceed, submit a Schedule of Submittals showing the date by which each submittal required for Product Review or Product Information will be made. Identify the items that will be included in each submittal (see paragraph 1.05 of this Section) by listing the item or group of items and the Specification Section and paragraph number under which they are specified. Indicate whether the submittal is required for Product Review of Proposed Equivalents, Shop Drawings, Product Data or Samples or required for Product Information only.

1.03 PLAN OF OPERATIONS

- A. Not used
- B. Before beginning on site work, submit a plan showing Contractor's intended use of the site assigned to it. Show location of enclosing fence, access points and gates. Show location for Contractor's, Subcontractor's, and Engineer's field office and parking. Show location of Contractor's and Subcontractor's work areas and storage areas.

1.04 CONSTRUCTION SCHEDULE

- A. See General Conditions.
- B. The Contractor's Construction Schedule shall be in the form of a computer generated network analyses diagram and supporting mathematical analysis using the Critical Path Method (CPM) under concepts and methods outlined in the Associated General Contractor's publication, "The Use of CPM's Construction - A Manual for General Contractors and the Construction Industry." Provide a copy of the software used to the Engineer.
 - 1. Draw network diagram to scale using actual calendar dates. Show work subdivided into identifiable activities within each trade such that no activity has a duration longer than five (5) working days. Show order and interdependencies of each activity.
 - 2. Use actual calendar dates to show planned and actual performance and show:
 - a. Preceding and following event numbers.
 - b. Activity description.
 - c. Estimated duration of activity.
 - d. Earliest start date.
 - e. Earliest finish date.
 - f. Actual start date.
 - g. Actual finish date.
 - h. Latest start date.
 - i. Latest finish date.
 - j. Total and free float.
 - k. Monetary value of activity, keyed to Schedule of Values.
 - l. Percentage of activity completed.
 - m. Dates for Making submittals of Proposed Equivalents, Product Data and Shop Drawings.
- C. If the Construction Schedule does not reflect the CPM format requirements, the specified work, or the Contract Time, it will be returned to the Contractor for modification.
- D. Revise the Construction Schedule and resubmit within seven (7) days following any monthly meeting to review Contractor's Application for Payment when Contractor's work is fifteen (15) days or more behind schedule.
- E. Accelerated Work if Required to Meet Schedule: See General Conditions. Give Engineer 3 days prior notice of construction that will take place outside of normal work hours or work days. Compensate Owner for extra inspection cost caused by Accelerated Work required to meet Schedule.
- F. Give Engineer 3 days prior notice of normal work days on which construction will not take place or of scheduled construction that will not take place. Compensate Owner for extra inspection cost resulting from failure to give notice.
- G. Unless otherwise specified, Contractor shall schedule all work to be completed within normal working hours. If Contractor completes work outside normal working hours and its work causes the Owner's staff to work overtime, then the Contractor shall be responsible for paying for the Owner's overtime costs.

1.05 SHOP DRAWING, PRODUCT DATA AND SAMPLES SUBMITTED FOR PRODUCT REVIEW

- A. This paragraph covers submittal of Shop Drawings, Product Data and Samples required for the Engineer's review referred to as Product Review submittals in the Technical Specifications (Division 2 through 16). Submittals required for information only are referred to as Product Information submittals in the Technical Specifications and are covered in paragraph 1.07 of this Section. See General Conditions.
- B. Number and type of submittals:
1. Shop Drawings.
 2. Product Data,
 3. Samples: Submit four labeled samples or three sets of samples of manufacturer's full range of colors and finishes. Comply with requirements in Technical Specification Sections. One sample will be returned to Contractor.
- C. The Contractor shall make all Product Review submittals early enough to allow adequate time for the Engineer's review, for manufacture and for delivery at the construction site without causing delay to the Work. Submittals shall be made early enough to allow for unforeseen delays such as:
1. Failure to obtain Favorable Review because of inadequate or incomplete submittal or because the item submitted does not meet the requirements of the Contract Documents.
 2. Delays in manufacture.
 3. Delays in delivery.
- D. Content of Submittals:
1. Each submittal shall include all of the items and material required for a complete assembly, system or Specification Section.
 2. Submittals shall contain all of the physical, technical and performance data required by the specifications or necessary to demonstrate conclusively that the items comply with the requirements of the Contract Documents.
 3. Include information on characteristics of electrical or utility service required and verification that requirements have been coordinated with services provided by the Work and by other interconnected elements of the Work.
 4. Provide verification that the physical characteristics of items submitted, including size, configuration, clearances, mounting points, utility connection points and service access points, are suitable for the space provided and are compatible with other interrelated items that are existing or have or will be submitted.
 5. Label each Product Data Submittal, Shop Drawing and Sample with the information required in paragraph 1.01A of this Section. Highlight or mark every page of every copy of all Product Data submittals to show the specific items being submitted and all options included or choices offered.
 6. Additional requirements for Product Review submittals are contained in the Technical Specification sections.
 7. Designation of work as "NIC" or "by others," shown on Shop Drawings, shall mean that the work will be the responsibility of the Contractor rather than the subcontractor or supplier who has prepared the Shop Drawings.

- E. Compatibility of Equipment and Material: Verify that items contained in the same or in different submittals meet the requirements in the paragraph titled "Material and Equipment in Section 01040 especially the subparagraphs titled "Compatibility of Material and Equipment."
- F. Requirements for Contractor Designed Items and for First Specified (Named) Items: Verify that items meet the requirements in the paragraph titled "Performance Specifications and Contractor Designed Items" in Section 01040.
- G. Requirements for the Contractor's review and stamping of submittals prepared by the Contractor or by Subcontractors or suppliers prior to submitting them to the Engineer are covered in General Conditions.
- H. Submittals that contain deviations from the requirements of the Contract Documents shall be accompanied by a separate letter explaining the deviations. See General Conditions. The Contractor's letter shall:
 - 1. Cite the specific Contract requirement including the Specification Section and paragraph number for which approval of a deviation is sought.
 - 2. Describe the proposed alternate material, item or construction and explain its advantages and/or disadvantages to the Owner.
 - 3. State the reduction in Contract Price if any that is offered to the Owner.
- I. Engineer's Review Procedure and Meaning:
 - 1. The Engineer will stamp and mark each Product Review submittal prior to returning it to the Contractor. The stamp will indicate whether or not the review was favorable and what action is required of the Contractor. Review categories "No Exceptions Taken" and "Make Corrections Noted" both indicate Favorable Review.
 - 2. The Engineer's Favorable Review is contingent on the Contractor's warranties required by General Conditions and is subject to all of the limitations and conditions in General Conditions. Favorable Review is also contingent on:
 - a. The compatibility of items included in a submittal with other related or interdependent items included in previous or future submittals.
 - b. Future submittal of items related to or required to be part of this submittal that were not included with this submittal.
 - 3. Favorable Review of a submittal does not constitute approval or deletion of items required as part of the submittal but not included with the submittal. Favorable Review of items included in the submittal does not constitute deletion of specified features, options or accessories that were not included in the submittal.
 - 4. The action required by the Contractor for each category of review is as follows:
 - a. NO EXCEPTIONS TAKEN. NO RESUBMITTAL REQUIRED.
 - b. MAKE CORRECTIONS NOTED:
 - (1) NO RESUBMITTAL REQUIRED. The Contractor shall make corrections noted prior to manufacture.
 - (2) PARTIAL RESUBMITTALS REQUIRED. The Contractor shall submit related accessory or optional items as noted which are required but were not included with the submittal and/or shall resubmit unsatisfactory portions or attributes of items as noted. The Contractor may proceed to manufacture those portions of the submittal that will be unaffected by required resubmittals.

- c. AMEND AND RESUBMIT. The Contractor shall amend and resubmit the submittal as noted or required to comply with the Contract Documents.
 - d. REJECTED - RESUBMIT. The item submitted does not comply with the Contract Documents in a major way. Resubmit items that comply with the requirements of the Contract Documents.
5. The letter of transmittal accompanying the returned Product Review submittal may contain numbered notes. Marking a corresponding number on a Shop Drawing or Product Data submittal shall have the same affect as applying the entire note to the submittal.
- J. Re-submittals that contain changes that were not requested by the Engineer on the previous submittal shall be accompanied by a letter explaining the change. See General Conditions.
- K. Favorable Review Required Prior to Proceeding: Do not proceed with manufacture, fabrication, delivery or installation of items prior to obtaining the Engineers Favorable Review of Product Review submittals. See General Conditions.
- L. Intent and Limitation on Engineer's Review:
- 1. See General Conditions.
 - 2. The Contractor has primary responsibility for submitting and providing work that complies with the requirements of the Contract Documents. That responsibility cannot be delegated in whole or in part to subcontractors or suppliers. Neither the Engineer's Favorable Review nor the Engineer's failure to notice or comment on deficiencies in the Contractor's submittals shall relieve the Contractor from the duty to provide work, which complies with the requirements of the Contract Documents.

1.06 PROPOSED EQUIVALENTS

- A. Submit Proposed Equivalent submittal form, and comply with the submittal requirements for Shop Drawings, Product Data, and Samples submitted for Product Review in another paragraph of this Section.
- B. See General Conditions.
- C. Time of Submittal:
- 1. General Conditions requires submittal of Proposed Equivalents within 35 days of the Notice to Proceed. The Engineer may agree to a later submittal date if requested in writing within 35 days of the Notice to Proceed. The request shall identify the item, give the Specification reference, and proposed manufacturer and model number of the item that will be submitted and the proposed submittal date.
 - 2. The Engineer's agreement to a later submittal date shall be in writing and shall not be construed as Favorable Review or acceptance of the manufacturer or item proposed.
- D. Content of submittals shall be the same as that required for Product Data, Shop Drawings and Samples submitted for Product Review in another paragraph of this Section. In addition, the Contractor shall provide information on several recent similar installations of the item to verify its suitability. The information shall include the project name and location, the Owner's name, address, telephone number and

name of a knowledgeable person to contact for information on performance of the product.

- E. When the Contractor has listed specific maker's products on Document Number 00445 List Of Equipment/Material Suppliers Form submitted with its Bid no changes will be permitted without submittal of acceptable evidence justifying the change and the Engineer's written approval.
- F. If a non-equivalent substitute is submitted for review, it shall be accompanied by a proposed reduction in Contract Price which shall include the increased cost of Engineering service required to evaluate the proposed substitute (which shall be paid to the Owner whether or not the substitute is accepted) plus the greater of
1) the difference in price between the first specified item and the item submitted and
2) the difference in value to the Owner between the two items.

1.07 PRODUCT INFORMATION SUBMITTALS

- A. See General Conditions.
- B. Product Information submittals are required for the Owner's permanent records and will be used for future maintenance, repair, modification or replacement work. Product Information submittals will be examined only to verify that the required submittals have been made; they will NOT be reviewed for compliance with the Contract Documents.
- B. Make Product Information submittals prior to delivering material, products or items for which Product Information submittals are required.
- C. The Contractor has the sole and exclusive responsibility for furnishing products and work that meets the requirements of the Contract Documents.
- D. The Engineer reserves the right to comment on any submittal and to reject any product or work delivered, installed or otherwise at any time that the Engineer become aware that it is defective or does not meet the requirements of the Contract Document. See General Conditions.

1.08 OPERATION AND MAINTENANCE MANUALS AND PARTS LISTS

- A. Submit in accordance with the requirements of Specification Section 01782.
- B. Submit at least 15 days prior to Facility Startup and Training specified in Section 01650, or prior to 75% completion, whichever is earlier.

1.09 MANUFACTURER'S CERTIFICATES

- A. Not used.
- B. When specified in Technical Specification section, submit manufacturers' certificate to Engineer for review. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate. Certificates may be recent or previous test results on material or Product, but must be acceptable to the Engineer.

1.10 CONSTRUCTION PHOTOGRAPHS

- A. Each month submit photographs to Engineer with Application for Payment.
- B. Not used.
- C. Take five site photographs from different directions and five interior or exterior photographs to show progress of the Work in each work area. Make photographs within 5 days of the Application for Payment Date.
- D. Identify photographs with date, time, orientation and project identification.
- E. Digital photographs in JPEG format may be acceptable.

1.11 NOT USED

1.12 NOT USED

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 – GENERAL

1.01 TEMPORARY UTILITIES

- A. Sanitary Facilities: Provide and maintain self-contained portable sanitary facilities for the Contractor' and subcontractor's use. Facilities shall comply with applicable regulations and shall be serviced, cleaned and disinfected as least weekly.
- B. Temporary Water, Power, and Telephone Service:
 - 1. Water and Power: Limited water and no electrical service will be available at the project site for the Contractor's use. Contractor shall obtain the approval from the Owner prior to making any connections to the Owner's water system. No charge will be made for this use provided utilities are not wasted. The Contractor shall provide temporary connection and distribution systems and remove them at the end of its work.
 - a. Water: The Contractor may make a single 3/4-inch pipe size connection to the Owner's existing potable water system. The Owner's water may be used to serve temporary offices and hose bibs. Use shall be limited to sanitary use, tool clean-up, intermittent concrete cure spraying, and similar minor uses. The Contractor shall provide water for other uses, such as dust control and compaction, by trucking water to the site or making other arrangement. The temporary connection to the Owner's water system shall be at a location approved by the Engineer and shall conform to requirements for a backflow prevention.
 - b. Power: The Contractor shall provide a "whisper quiet" electric generator or separate electric service, at the Contractor's expense, for all loads, including services to the Contractor's office, and any temporary structures requiring electrical service.
 - 2. Telephone: Contractor shall furnish a 24 hour per day phone number of the Contractor's superintendent, or other key staff.
- C. Temporary Heat: Supply temporary heating equipment as required to maintain conditions necessary for construction operations.
- D. Temporary Ventilation: Provide equipment to ventilate enclosed areas to facilitate curing concrete, to dissipate humidity and to prevent accumulation of dust, fumes, or gases as needed. Utilize ventilation equipment and supplement with temporary fans to maintain clean air and safe conditions for construction operations. Replace or clean filters on existing or new equipment on completion.
- E. Dissipation of Hazardous Fumes Prior to Completion and Occupancy by Owner: Provide high capacity fans and heaters or use existing or new equipment to provide 100% fresh air for several days to dissipate hazardous fumes from new construction materials such as paint, adhesives, carpet and wall coverings.

- F. Temporary Lighting: Provide and maintain lighting for construction operations to achieve a minimum lighting level of 20-foot candles for rough work and 60-foot candles for finish work.
- G. Temporary Fire Protection:
 - 1. Provide and maintain fire protection equipment, including extinguishers, fire hoses, and other equipment required by law, insurance carriers, or necessary for proper fire protection during the course of the work.
 - 2. Use fire protection equipment only for fighting fires.
 - 3. Locate fire extinguishers in field offices, storage sheds, tool houses, temporary buildings, and throughout the construction site. *[In the area under construction, provide at least one fire extinguisher for each 5,000 square feet of enclosed space and locate fire extinguishers not over 100 feet apart.]*

1.02 TEMPORARY CONSTRUCTION

- A. The Contractor is solely and exclusively responsible for the design, construction and maintenance of all temporary construction including forms, falsework, shoring, scaffolding, stairs, ladders and all other similar items. See General Conditions and Section 01040.
- B. Construct adequate and safe forms and falsework, to rigidly support partially completed structures. Provide temporary bridges and decking to maintain vehicular and pedestrian access. Design and construct temporary forms, falsework, bridges and decking in accordance with applicable regulations and codes.

1.03 BARRICADES, FENCES AND ENCLOSURES

- A. See General Conditions and Section 01040.
- B. Barricades: Provide temporary guard rails, ladders, stairs, guards, and barricades to protect persons in accordance with applicable regulations, including California Code of Regulations Title 8 and Cal/OSHA.
- C. Fences:
 - 1. Existing fences enclose the present facilities site. The fences are for the protection and security of the present operating facilities. If it is necessary for the Contractor to remove some of the fences for installation of new work, the Contractor shall provide equivalent temporary protection and security. Replace fencing removed by the Contractor with new fencing of equivalent quality prior to completion.
- D. Enclosures:
 - 1. Provide protective dust covering at doors and other openings to contain dust within the construction area.
 - 2. Provide temporary partitions to prevent dust and moisture from entering Owner-occupied areas and to prevent damage to existing materials and equipment. Temporary partitions shall be of non-combustible construction such as metal studs and gypsum board.

3. Provide temporary watertight closures for openings in exterior surfaces as required to protect interiors from weather, moisture, humidity and extreme temperature.

1.04 PROTECTION OF INSTALLED WORK

- A. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.
- B. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by covering.
- C. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is unavoidable provide adequate protection to prevent damage to waterproof membranes and comply with recommendations for protection of the waterproofing or roofing material manufacturer.
- D. Provide heavy planking to protect curbs, gutters, culverts, paving and similar surfaces from damage by heavy equipment or vehicles.

1.05 SECURITY

- A. The Owner's site is fenced, and unauthorized vehicle access is maintained by an access gate. As needed, Contractor shall provide additional security and facilities to protect the Work, from unauthorized entry, vandalism, or theft.
- B. Not used.

1.06 SITE ACCESS AND PARKING AREAS

- A. Working hours. Unless otherwise approved through a written authorization by the Owner, Contractor working hours shall be **7:00 am to 4:30 pm**, Monday through Friday, except Owner holidays.
- B. Access to the site is controlled by a locked gate. The Owner will issue to the Contractor temporary keys to open the site's gate during the hours noted above.
 1. The delegated Contractor person(s) must maintain control of the gate key at all times, and **the Contractor will advise the Owner immediately if any access key is lost or stolen.**
 3. The keys must be returned to the Owner at the conclusion of work on this project, and Owner may elect to not accept the project as complete until they are returned.
- A. Parking. Contractor's workers shall park vehicles in the Contractor's staging areas as shown on the Drawings.

1.07 TEMPORARY CONTROLS

- A. Cleaning:
 1. During Construction: Maintain the site and all work in a clean orderly fashion free of waste debris and rubbish. Store debris and rubbish in covered

containers. Food waste and other debris than can attract vectors shall be stored in covered containers at all times. Pick up and remove debris daily if required, but not less frequently than weekly. Burning debris on site is not permitted. Remove debris from permanently closed spaces prior to enclosing them. Clean mud from vehicles before leaving the site.

2. If work under this Contract creates dusty, dirty or unsightly conditions in adjacent areas, the Contractor shall immediately cleanup the affected areas.
3. Final cleanup is specified in Section 01700.

- B. Dust Control: Employ measures to prevent the creation of dust which may produce damage or nuisance to property or persons. Be responsible for all damage resulting from dust produced by construction operations. Periodically wet down unpaved areas where vehicles are operated. See Earthwork specification sections.
- C. Erosion and Sediment Control: Employ measures to prevent erosion and trap any sediment created by construction operations before it leaves the site. Prevent sediment from entering streams or other water bodies. Grade any areas damaged by construction or by erosion and hydroseed with grass.
- D. Noise Control: Comply with regulations limiting construction noise levels. Use whisper quiet air compressors. Use jack hammers with exhaust mufflers. Prevent noise disturbance to the public and adjacent property owners.
- E. Pest and Rodent Control: Avoid creating conditions conducive to pests and rodents. Comply with regulations governing the use of chemicals to control pests and rodents.
- F. Water Control: Maintain excavations free of water.

1.08 PROTECTION OF TREES

- A. Remove only those trees designated on the Drawings for removal. Protect all other trees on the site or locations affected by construction activities.
- B. Protect all trees on the site from damage. Do not cut roots larger than 2 inches in diameter during excavating or trenching operations.
- C. Do not attach ropes, cables, guys or braces to trees.
- D. Do not trim any trees without the Engineer's authorization.

1.09 TRAFFIC REGULATION

- A. Conduct operations so as to offer the least possible obstruction and inconvenience to public traffic. Do not overload or damage paved or improved surfaces, sidewalks, curbs or gutters.
- B. Provide temporary barricades, lights, flag persons and other means to safely control pedestrian and vehicular traffic entering and leaving the project site and on the project site.

1.10 PROJECT SIGN

- A. Provide an 8 foot-wide by 4 foot-high project sign using 3/4-inch exterior grade plywood and braced wood frame construction. Paint all surfaces with two coats of exterior house paint. Employ a professional sign painter to letter sign in accordance with Engineer's small scale design and color selection (two colors).
 - 1. List project title and names of Owner, Engineer, and Contractor.
 - 2. Erect the sign where directed by the Engineer. Locate bottom edge of the sign 8 feet above the ground. Maintain sign in good condition and remove it on project completion.

1.11 FIELD OFFICES

- A. Contractor's Office at the Site: Maintain a suitable office at the site for the Contractor's Superintendent who shall be authorized to receive submittals, drawings, instructions, or other communications from the Engineer or the Owner.
- B. Engineer's Office at the Site: Not used.

END OF SECTION

SECTION 01650

FACILITY STARTUP

PART 1 – GENERAL

1.01 FACILITY STARTUP

- A. 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. To ensure that the work is ready for full-time operation the procedures include verification, balancing, calibration, witness testing, documentation, inspection by equipment manufacturers and operator training where specified.
- B. Notification: Notify the Engineer 7 days prior to starting each system or piece of equipment.
- C. Coordination: During the startup period, coordinate the operation of the facility with Engineer, subcontractors, Owner's operators, and manufacturer's representatives.
- D. Furnish test equipment, measuring devices and supplies required to conduct tests.
- E. Maintain the equipment until acceptance. Provide all lubricants, chemicals, and electricity necessary until acceptance.
- F. Furnish all expendable supplies, gas, water, etc., required for startup, demonstration and testing and dispose of all waste or used supplies, water, etc.

1.02 SUBMITTALS

- A. Startup Plan, Forms, and Schedule: Prepare a facility startup plan and schedule. The plan shall include test methods and procedures and sample forms for recording test data.
- B. Affidavit.
- C. Submit documentation of tests, balancing reports, and the like.

1.03 INITIAL STARTUP AND OPERATION OF FACILITIES

- A. The following listing is a general sequence of startup activity steps to be used in placing facility systems into operation:
 - 1. Perform initial lubrication of equipment and have manufacturers check and adjust equipment. Provide all subsequent lubrication and maintenance, and such staff as required for test operation until the Owner assumes equipment maintenance responsibility after Step 14 below.
 - 2. Perform satisfactory testing of electrical work required prior to energizing of the electrical system.

3. After completion of Step 2, perform satisfactory electrical testing required after energizing of the electrical system.
4. Complete calibration of instruments.
5. Satisfactorily complete system verification of instrumentation work.
6. After completion of Steps 1 and 3, perform a rotational test of equipment and correct backward rotating drives.
7. After completion of Steps 5 and 6, test operate the equipment by manually initiating the operation. Where manual operation bypasses alarm or safety monitoring, provide continuous supervision of such parameters. Perform this step using water in lieu of chemicals or other process liquids. Use dry air or nitrogen in lieu of hazardous gases.
8. Concurrent with Step 7, perform instrumentation and control testing and adjustments as related to the equipment being tested.
9. Concurrent with Step 7 and where possible at this stage of startup, complete the performance testing specified for the equipment.
10. Concurrent with Step 7, perform adjustments of the electrical work as related to the equipment being tested.
11. Repeat Steps 1 through 10 as required for other equipment items and plant systems until all plant process components and utility systems are ready for total plant operation. It may be necessary for the Contractor to put portions of the newly constructed facility in service before constructing other portions of the facility or completing the Work as a whole.
12. Notify the Owner and the Engineer 30 days before total plant operation is to occur so that the Owner may order chemicals and make other arrangements for full time operation. This notification shall have an accuracy of plus or minus 7 days. Notify the Owner and Engineer again, exactly 7 days before total plant operation is to begin.
13. Upon completion of all the above steps, the facility shall be started up and operated on a complete full time basis beginning on the indicated date. The Owner will provide operating personnel, chemicals and untreated water. For five consecutive days beginning with the start-up day, the Contractor shall have at the plant site, during the day shift, a mechanic, an electrician and an instrument engineer. Representatives of manufacturers of critical equipment shall also be present for these five days as needed or as required elsewhere in the specifications. The Contractor shall also provide these personnel, on a 24-hour per day, "on call" basis, if necessary, to adjust, repair, and correct deficiencies as required to keep the facilities in continuous operation for a period of 30 days. The Contractor shall train the operators in the proper operation and the control of the new facilities. The Contractor shall also furnish all such mechanical and electrical workers as required to make adjustments to and perform all required maintenance for the operating equipment until the end of the 30-day initial operation period. Maintenance of operating equipment shall include lubrication, adjustments, replacements, and modifications as required.
14. Unless specified otherwise, after successful completion of the 30-day initial operation period, the Owner will take over maintenance duties as well as operation and will begin to provide and pay for lubricants. If continuous process operation is interrupted for a period of four consecutive hours or more due to a failure of the equipment or work provided by the Contractor, then the counting of the 5-day and/or 30-day periods, described in Step 13 above, shall be restarted at day one if these periods have not reached satisfactory completion.
15. Following the commencement of Step 13, satisfactorily complete equipment performance testing, electrical testing and adjustments, and

instrumentation/control testing and adjustments to the extent that such testing and adjustments could not be made prior to full plant operation.

16. Complete the documentation of test, balancing reports, and the like commissioning for submittal during the startup process and before acceptance.

1.04 MANUFACTURER'S FIELD SERVICE AND AFFIDAVITS

- A. Field Service: Where specified, manufacturers of equipment shall provide field service. Field service shall be provided by a manufacturer authorized, factory-trained technician or engineer for the specific equipment. Equipment shall not be considered ready for full time operation until after the manufacturer's representative has checked and adjusted the equipment, and certified by written affidavit that the equipment has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation.
- B. Affidavits: Acceptable affidavits shall be submitted prior to completion of the work.
 1. Affidavits shall contain the following specific wording:

"The *[Name of Equipment]* has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full time operation. The installation has been inspected and has been found to be in conformance with our (the manufacturer's) standards and requirements."
 2. No amplification, dilution, or modification of this specific wording will be permitted.

1.05 TRAINING

- A. Submit Operation and Maintenance Manuals and Parts Lists specified in Section 01300 at least 30 days prior to the first training session.
- B. Demonstrate the operation, maintenance and safety procedures for all systems and equipment to personnel designated by the Owner.
- C. Unless otherwise specified, provide a total of 8 hours of classroom training for equipment in each technical specification section and a total of 8 hours of onsite demonstration of systems and equipment. Training and demonstrations shall be conducted in two separate sessions of 4 hours each.
 1. Illustrate classroom training with diagrams, checklists, photographs and other visual aids as appropriate. Use video, slides, or overhead projector to present visual materials.
 2. Prepare a course summary illustrated with copies of visual materials. Distribute one copy to each course attendee, four copies to the Owner and two copies to the Engineer.
 3. Training shall be conducted by a manufacturer authorized, factory trained, technician or engineer.
 4. The Owner reserves the right to videotape any training session. The Contractor shall accommodate the Owner's requirements to complete the videotaping.
- D. In addition to overall training specified above, provide special demonstration and training for specific pieces of equipment specified in the Technical Specification Sections.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

PART 1 – GENERAL

1.01 FINAL CLEANUP

- A. Prior to Final Inspection clean the entire construction area and all other areas affected by the performance of work under this Contract. Perform cleaning using personnel specializing in and skilled in cleaning and maintenance work. Perform repair work using personnel skilled in executing the type of work being repaired. Perform all work to the highest trade standards applicable to that type of work.
1. Remove all temporary construction, signs, tools, equipment, excess material and debris.
 2. Remove all lumps, splatters, spots and stains caused by paint, adhesive, asphalt, concrete, mortar, sealant or other foreign material from exposed or finished surfaces. Remove all temporary labels.
 3. Repair, patch or replace new or existing work including pavement, sidewalks, curbs, gutters, catch basins, gratings, manholes, covers, landscaping, plant materials and other items that have been damaged, broken, cracked or chipped as a result of performing this Work.
 4. Sweep clean and wash down all exterior pavement. Remove all hazardous material and material that may cause sediment in drainage systems prior to washdown. Remove all grease and oil stains on pavement caused by Contractor's equipment.

1.02 CONTRACTOR'S ACTION LIST OF ITEMS TO BE CORRECTED AND/OR COMPLETED

- A. During construction, the Contractor shall maintain an action list of items to be corrected and/or completed. The Contractor shall regularly add items and update the list as information becomes available or as requested by the Engineer. The Contractor shall deliver a current copy of the list to the Engineer at each progress meeting.

1.03 SEMIFINAL INSPECTION/SUBSTANTIAL COMPLETION

- A. See General Conditions. When the Contractor considers the Work nearly complete, the Contractor shall review the Contract Documents, inspect the Work, and use the Contractor's action list to prepare a Contractor's Punch List of all deficient or uncompleted items. The Contractor shall complete or correct items on the Punch List. When the Work is Substantially Complete in accordance with General Conditions, the Contractor shall notify the Engineer in writing that the Contractor has reviewed the Contract Documents, inspected the Work and believes that the Work is Substantially Complete and ready for Semifinal Inspection.
- B. See General Conditions. On receipt of the Contractor's Punch List and notice that the work is ready for Semifinal Inspection, the Engineer will inspect the Work. The Engineer may add additional items to the Contractor's Punch List, may find that the work is not ready for inspection, is ready for inspection but not Substantially

Complete or that the Work is Substantially Complete. When the Engineer finds the Work is Substantially Complete, it will prepare a Final Punch List and a notice of Substantial Complete, which will state the date of Substantial Completion and the time agreed to by the Owner and the Contractor (not to exceed 30 days) in which the Work shall be fully complete and ready for Final Inspection.

1.04 FINAL INSPECTION, FINAL COMPLETION AND FINAL PAYMENT

- A. See General Conditions. When the Contractor has completed or corrected all the items on the Engineer's Final Punch List, the Contractor shall give the Engineer written notice that the Work is ready for Final Inspection. When the Engineer finds the Work acceptable and fully complete in accordance with the Contract Documents, and upon receipt of a final Application for Payment and all final submittals, the Engineer will recommend that the Owner issue a Notice of Final Completion, make Final Payment and Accept the Work stating that to the best of the Engineer's knowledge, information and belief, and on the basis of the Engineer's observations and inspection, the Work has been fully completed in accordance with the terms and conditions of the Contract Documents.
- B. Final Submittals include:
 - 1. Operation and Maintenance Manuals and Parts Lists
 - 2. Record Drawings
 - 3. Extra Materials
 - 4. Special Guarantees
 - 5. Maintenance Contracts
 - 6. Insurance Certificate showing required continuation of coverage beyond Final Payment. See General Conditions.
 - 7. Release of Liens. See General Conditions.
 - 8. Waiver of Claims by Contractor. See General Conditions.
 - 9. And any other submittals required by the Contract Documents and not previously received.
- C. The Owner will record the Notice of Final Completion at the County Recorders Office.
- D. The Owner will make Final Payment to the Contractor 35 days after recording the Notice of Final Completion.

1.05 RECORD DRAWINGS

- A. The Contractor shall maintain on the jobsite, a complete set of Contract Documents and a complete file of all addenda, contract modifications and favorably reviewed submittals. The Contractor shall prepare a set of Record Drawings concurrently with the construction of the Work and in accordance with General Conditions and the following:
 - 1. Show the invert elevation of all gravity piping and the top of pipe, top of conduit or top of protective concrete encasement for other utilities. Elevations shall be related to a permanent visible elevation benchmark by the Contractor.
 - 2. Show the horizontal location of underground utilities measured from permanent visible physical features such as face of building, face of tank, or centerline of manhole.

3. Comply with detailed requirements in technical specification sections describing the type of information required on Record Drawings. The Contractor's copy of Contract Documents, Contract modifications and Record Drawings shall be available to the Engineer for weekly verification that the records are being currently updated.

B. Not Used.

C. Submit Record Drawings and obtain acceptance prior to completion.

1.06 EXTRA MATERIALS

- A. Deliver specified extra materials and parts to Engineer. Itemize all items on a transmittal letter in duplicate and obtain signature of receiving party. Submit copies of signed transmittals for all specified extra materials and parts prior to completion.

1.07 SPECIAL GUARANTEES

- A. General Conditions covers the Contractor's responsibility to remedy defects due to faulty workmanship and materials, which appear within one year from the date of Final Completion and acceptance by the Owner.
- B. Guarantees for more than one year when called for in various sections of the Specifications shall be evidenced by the Contract Documents and in the form of a special guarantee written on the letterhead of the Contractor, Subcontractor, or Supplier doing the work and/or supplying the item to be guaranteed, and countersigned by the Contractor as follows. Failure to provide the special guarantee on the letterhead shall not relieve the Contractor, Subcontractor, or Supplier from its obligations for the special guarantees.
- C. Special Guarantee:

We hereby guarantee that the _____ which we have provided in the _____, Project, was done in accordance with the Drawings and Specifications, and that the work, as installed, will fulfill the requirements of the guarantee included in Specification Section _____. We agree to repair or replace any or all of our work, together with any other adjacent work which may be damaged or displaced by so doing, that may prove to be defective in workmanship or material (with the exception of defects due to ordinary wear and tear, and unusual abuse or neglect) within a period of _____ years from the date of acceptance of the abovenamed facility, without any expense whatsoever to the Owner. In the event of our failure to comply with the above-mentioned conditions within the period set forth in the General Conditions after being notified in writing by the Owner, we, collectively or separately, do hereby authorize the Owner to proceed to have said defects repaired and made good at our expense, and we will honor and pay the costs and charges therefor upon demand. We understand that the provisions of General Conditions apply to this Special Guarantee.

Signed _____
(Subcontractor or Supplier)

Company _____

Address _____

Telephone Number _____

Countersigned _____
(Contractor)

- D. Submit two notarized original signed copies of each required Special Guarantee prior to completion.

1.08 TWELVE-MONTH INSPECTION

- A. Thirty (30) days prior to the expiration of the one-year guarantee period described in General Conditions, the Contractor shall tour the project with the Engineer and/or the Owner to prepare a list of corrective work required under the 12-month guarantee. The Contractor shall correct all items found to be defective within 20 days of receipt of the list of items to be corrected.

1.09 MAINTENANCE CONTRACTS

- A. The Contractor shall deliver original signed copies of prepaid contracts for maintenance of equipment or systems in accordance with detailed requirements contained in technical specifications sections.

END OF SECTION

SECTION 01782

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Preparation and submittal of Operation and Maintenance Manuals. Operations and Maintenance information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this contract.

1.02 SUBMITTALS

- A. Submit Operation and Maintenance Manuals. The Manuals must be accepted by the ENGINEER before field quality control testing and before training of OWNER's staff for each piece of equipment or system may start.
- B. Submit 5 Manuals for review and 5 Manuals after acceptance for each piece of equipment or system.
- C. Make accepted manuals available at project site for use by construction personnel and ENGINEER.

1.03 OPERATION AND MAINTENANCE MANUALS

- A. Preparation:
 - 1. Provide Operations and Maintenance Manuals in 3-ring McBee swing hinge type binders, or equal. Size and color of binders to be approved by the Owner. Utilize properly labeled tab titles on tab sheets to organize contents of manuals.
- B. Contents of Operation And Maintenance Manuals:
 - 1. Cover Page: Equipment name, equipment tag number, project name, OWNER's name, appropriate date.
 - 2. Table of Contents: General description of information provided within each tab section.
 - 3. Equipment Summary Form: Completed form in the format attached at the end of this Section. Insert Equipment Summary Form after the tab sheet of each equipment section. The manufacturer's standard form will not be acceptable. Manuals submitted without equipment summary form fully completed, including equipment identification number, will be rejected and returned.
 - 4. Lubrication Information: Required lubricants and lubrication schedules.
 - 5. Control Diagrams:
 - a. Internal and connection wiring, including logic diagrams, wiring diagrams for control panels, ladder logic for computer based systems, and connections between existing systems and new additions, and adjustments such as calibrations and set points for relays, and control or alarm contact settings.

6. Start-up Procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.
7. Operating Procedures:
 - a. Step-by-step procedures for starting, operating, and stopping equipment under specified modes of operation.
 - b. Include safety precautions and emergency operating shutdown instructions.
 - c. For Complex Equipment provide in addition:
 - 1) Alternate specified operating modes.
 - 2) Emergency shutdown instructions.
 - 3) Normal shutdown instructions.
 - 4) Long-term shutdown instructions.
8. Preventative Maintenance Procedures: Recommended steps and schedules for maintaining equipment.
9. Overhaul Instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.
10. Parts List: Generic title and manufacturer's identification number of each component part of equipment; include bearing manufacturer, model and ball or roller pass frequencies for every bearing.
11. Spare Parts List: Recommended number of parts to be stored at the site and special storage precautions. Include manufacturer's part number for all parts.
12. Drawings: Exploded view or plan and section views with detailed callouts.
13. Provide electrical and instrumentation schematic record drawings.
14. Source (Factory) Quality Control Test Results: Provide copies of factory test reports as specified in Sections 15050 or the equipment section.
15. Field Quality Control Test Results: After field-testing is completed, insert field test reports as specified in Sections 15050 or the equipment section.
16. Warranty Information: List and explain the various warranties and include the servicing and technical precautions prescribed by the manufacturers or contract documents to keep warranties in force.
17. Manufacturer's life cycle information in a format to be easily added to the Owner's NEXGEN Asset Management Module.

C. Electronic Copy:

1. All manuals shall be provided in an electronic format which entails all information included by the CONTRACTOR in the 3 ring binders within 45 days after acceptance of the manual by the ENGINEER and OWNER. This will include providing the following electronic format documents:
 - a. All text portions of the Operations and Maintenance Manual specifically tailored for this project shall be provided in searchable PDF format.
 - b. All graphical portions of the Operations and Maintenance Manual specifically tailored for this project shall be provided in GIF (schematics, line drawings, etc.) or JPEG (photos, etc.) format.
 - c. All shop drawings shall be provided in AutoCAD format - latest release at time of O&M preparation.
 - d. All forms (including the Equipment Summary Form) that may be required for maintenance shall be provided in MS EXCEL format.

- e. All other documents, including, but not limited to, brochures that need to be scanned that are specifically tailored for this project shall be provided in a searchable PDF format.

PART 2 PRODUCTS (Not used.)

PART 3 EXECUTION

3.01 PAYMENT

- A. Acceptable O&M information for the project must be delivered to the Construction Manager prior to the project being 75 percent complete. Progress payments for work in excess of 75 percent completion will not be made until the specified acceptable O&M information has been delivered to the Construction Manager.

3.02 FIELD CHANGES

- A. Following the acceptable installation and operation of an equipment item, the item's instructions and procedures shall be modified and supplemented by the CONTRACTOR to reflect any field changes or information requiring field data.

END OF SECTION

Equipment Summary Form

1. Equipment Item:

Is it a packaged unit, i.e. pump, motor, shaft? Yes ___ No ___

If yes, please detail: _____

2. How many: _____

3. Cost: _____ (Break down by component level (pump, motor, etc.)

4. Manufacturer: _____

Address: _____

Phone #: _____ Fax: _____

Email: _____ Website: _____

5. Equipment Identification Numbers:

Serial Number: _____

Model: _____

Part #: _____

Equipment ID No.: _____

6. Location of Equipment: _____

7. Weight of Individual Components (Over 100 Pounds): _____

8. Nameplate Date:

Horsepower: _____ RPM: _____

Amperage: _____ Size: _____

Voltage: _____ Frame Size: _____

Service Factor (S.F.): _____ Seal Size: _____

Speed: _____ Seal Type: _____

Enclosure Type: _____ Seal MOC: _____

Bearings: _____

GPM: _____ Impeller Size: _____

Maximum Capacity @ _____ ft TDH Other: _____

Design Point Capacity @ _____ ft TDH

9. Manufacturer's Local Representative:

Name: _____

Address: _____

Telephone Number: _____

Email: _____ Website: _____

10. Maintenance Requirements (including schedules):

TASK	SCHEDULE

11. Lubricant List:

12. Parts List (with accurate part #'s):

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13. Spare Parts (Recommended on Hand) (with accurate part #'s):

14. Comments: _____

15. General Info:

Year Installed: _____

Expected Life: _____

Project Name and Number: _____

Design Engineer: _____

16. Warranty:

Start Date: _____

Expiration Date: _____

Prorated: _____

SECTION 02050

DEMOLITION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide all demolition required to perform the work covered under this contract including without limitation:
 - 1. Remove existing construction shown to be removed.
 - 2. Remove and replace existing construction and/or finishes as required to provide access to perform other work included in this contract.
 - 3. Include removal of mechanical and electrical work that is to be abandoned and is contained in construction to be removed whether or not the mechanical and electrical work is shown. Disconnect and cap off utilities in accordance with applicable codes and safety regulations.
 - 4. Where utilities that are not shown pass through construction that must be removed and those utilities serve other areas notify the Engineer before disrupting service. If rerouting is required to maintain service, the Owner may issue a Change Order to accomplish the required work.
 - 5. Store and protect items intended for reuse.
 - 6. Assume ownership of debris and unwanted materials, remove from the site and dispose of legally.
 - 7. Include the cost of removing and disposing of hazardous material including without limitation asbestos or asbestos-containing material, lead-containing paint, and PCBs. If the presence of a hazardous material is suspected, have material tested. If material is identified as hazardous, retain qualified and licensed specialist to remove and dispose of it legally.
 - 8. If illegal electrical wiring is encountered such as "BX" or nonmetallic sheathed cable, notify the Engineer.
 - 9. Seven days prior to demolishing any existing items, ask the Owner whether they want to salvage the item. If the Owner wants the item, then carefully remove the item so that it is not damaged.
 - 10..
- B. Related Sections:
 - 1. Section 02300: Earthwork

1.02 NOISE AND DUST CONTROL

- A. Perform work in accordance with requirements in Division 1. Particular attention is directed without limitation to paragraphs titled: Owner and Contractor's Use of Premises, Cleanup During Construction, Fire Protection During Construction, Maintenance of Exit Routes for Building Users, Temporary Dust Barriers, Noise Control and Care of Existing Facilities.
- B. Provide temporary partitions to control dust and noise and exclude unauthorized persons.

- C. Perform work in a manner to cause least disturbance to building occupants/nearby residences and least damage to work to remain.
- D. Maintain adequate means of safe, clear egress for building occupants.
- E. Employ all available techniques for construction noise abatement. Use remote, well-muffled air compressors and newest noise suppressed pneumatic and electric tools.

1.03 WARNING

- A. The Contractor is advised that work under this Section may be hazardous. The Contractor is to take all necessary precautions to ensure the safety of workers and property. Removal of and/or working in areas containing even minor amounts of hazardous material including without limitation, asbestos, lead-based paint, PCBs or other hazardous materials requires special precautions, knowledge and procedures. If hazardous material is suspected, notify the Owner.

PART 2 - PRODUCTS

Not Used

PART 3 - EXECUTION

3.01 REMOVAL OF CONSTRUCTION IN AREAS TO RECEIVE NEW WORK

- A. Remove all unwanted mechanical and electrical work (whether shown or not) that is not wanted and is not needed to serve other areas that is in, on, or concealed behind work being removed. Cap off or terminate all mechanical or electrical work in accordance with the requirements of Divisions 15 and 16.
- B. Protect mechanical and electrical work that serves other areas. Relocate concealed mechanical and electrical work that is required to preserve service to other areas.
- C. Remove structural work designated for removal. Take precautions not to damage structural work intended to remain. Where temporary shoring is needed, submit a design prepared by an appropriately licensed engineer for review before proceeding.
- D. If structural elements are encountered that were not shown, protect them from damage and report their presence to the Engineer.

3.02 REMOVAL OF LIMITED PORTIONS OF EXISTING CONSTRUCTION TO PERMIT MODIFICATIONS

- A. Provide careful, selective cutting and removal of existing construction as required to permit relocation or modification of partitions, doors, or openings. Cut and remove the least amount of work possible except when a larger area needs to be removed to permit strengthening existing construction or when required to remove finishes to a natural break line such as a corner or change in material.
- B. Protect existing construction to remain with temporary coverings.

- C. Treat existing mechanical, electrical or structural work as described in other parts of this Section.
- D. When modifications are complete, replace removed work with new construction and finishes to match adjacent existing work. Standards of material and workmanship shall be in accordance with other portions of this Specification or if not covered then in accordance with current practice for this class of work. Salvaged materials may be used for replacement if in good condition.

3.03 REMOVAL OF EXISTING CONSTRUCTION TO PROVIDE ACCESS TO PERFORM WORK

- A. Provide careful selective cutting and removal of existing construction where required to permit installation of new concealed mechanical or electrical work, or installation of equipment, fixtures or devices.
- B. Treat existing mechanical, electrical or structural work as described in other parts of this Section.
- C. Replace and/or patch removed construction and finishes in accordance with other parts of this Section.

3.04 PROTECTION OF WORK TO REMAIN

- A. Protect all work to remain. Repair damage with materials, workmanship and finishes matching existing work when new.
- B. Most existing floor finishes will not be replaced in this contract. It is essential that these floors be protected from any damage due to impact, dirt, abrasion, paints and solvents.

3.05 CUTTING HOLES IN CONCRETE AND/OR CONCRETE UNIT MASONRY

- A. The Contractor is cautioned that electrical conduits and reinforcing that are not shown on drawings may be concealed in concrete CMU construction. Use electronic detection equipment to locate concealed items before cutting holes. Take all required precautions to avoid damage to existing conduits or reinforcing.
- B. New openings in existing concrete walls or slabs may be saw cut to opening perimeter lines where drawings do not call for adding reinforcing trim bars to strengthen openings. Do not run saw kerfs past corners of openings. Complete concrete removal at opening corners by chipping and grinding. Take all required precautions to avoid water damage to existing construction or the Owner's property.
- C. Where drawings call for adding reinforcing trim bars to strengthen openings, limit saw cutting to a depth of 3/4-inch to avoid cutting existing reinforcing steel. Carefully chip out concrete to avoid damaging existing reinforcing steel which is to remain.
- D. Use chipping guns to chip out small holes for pipes or conduits. Proceed carefully to avoid damage to concealed conduits. Core drilling is permitted only at the Contractor's risk and only with the Engineer's permission. If core drilling is used, the

Contractor shall: 1) use electronic detection equipment to locate conduit before drilling, 2) take precaution to avoid water damage to existing construction or the Owner's property, and 3) replace, at its own expense, any damaged electrical or signal wiring or conduits.

3.06 REMOVE UNWANTED FIXED EQUIPMENT

- A. If items are designated on the Drawings to be salvaged, remove them carefully without causing damage. Deliver items to be turned over to the Owner at location designed by the Owner. Store and protect items to be reused until time of need on jobsite.

3.07 IF HAZARDOUS MATERIALS ARE ENCOUNTERED

- A. If hazardous materials are discovered, comply with paragraph 1.01 of this Section and all applicable laws.

3.08 REMOVAL AND DISPOSAL OF MATERIAL

- A. Use debris chutes with covered tops emptying into covered containers.
- B. Use rubber tired covered buggies with rubber bumpers to transport debris through occupied sections of buildings.
- C. Store debris in suitable covered containers located where directed by the Owner and remove from site when full. Burning on the site is not permitted.
- D. Removed material (other than material to be reused) shall become the property of the Contractor who shall remove it from the site and dispose of it in a legal manner.

END OF SECTION

SECTION 02065

CONTROLLED LOW STRENGTH MATERIAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: This Section covers the work necessary for backfilling in confined areas around structures, pipelines or trenches, where specified or where access for compaction equipment is limited.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM) Standard Specification or Test Method:
 - 1. ASTM C33 Concrete Aggregates
 - 2. ASTM C94 Ready-Mixed Concrete
 - 3. ASTM C143 Slump of Hydraulic-Cement Concrete
 - 4. ASTM C150 Portland Cement
 - 5. ASTM C260 Air-Entraining Admixtures for Concrete
 - 6. ASTM C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
 - 7. ASTM C685 Concrete Made by Volumetric Batching and Continuous Mixing
 - 8. ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - 9. ASTM D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders
- B. American Concrete Institute (ACI):
 - 1. ACI 229 Controlled Low Strength Materials (CLSM)
 - 2. ACI 304 Guide for Measuring, Mixing, Transporting and Placing Concrete
- C. State of California, Department of Transportation (CALTRANS):
 - 1. Section 19-3.062 Slurry Cement Backfill
 - 2. Section 19-3.025 Soil Cement Bedding
- D. The 2007 California Building Code (CBC).

1.03 DEFINITIONS

- A. Controlled Low Strength Material (CLSM): A mixture of portland cement, fly ash, aggregates and admixtures proportioned to provide a nonsegregating, self-consolidating, free-flowing and hand-excavatable material, which will result in a hardened, dense, nonsettling fill.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data:
 - 1. Concrete mix product certification: Submit certified laboratory test results that the mix proportions and materials comply with these Specifications. Submit

certification on cementitious products and aggregates performed within the past 6 months.

- a. Cementitious materials.
- b. Coarse and fine aggregates.
- c. Admixtures.
- d. Water.

C. Quality Assurance/Control Submittals:

1. Design Data: Submit a mix design for the material to be used.
2. Test Reports: Submit trial laboratory and testing data with cylinder breaks performed at 7, 14, and 28 days.
3. Certificates: Ready-mix plant certification.

1.05 QUALITY ASSURANCE

A. Certifications:

1. Products and Materials Tests: Certified by independent commercial testing laboratories.
2. Mix Designs: By an independent commercial testing laboratory, complying with ASTM C1077 and favorably reviewed by the Engineer. Mix design proportions shall be established on the basis of field experience and trial mixtures with the materials to be employed in accordance with CBC Section 1905.
3. Mix Test Results.
 - a. Submit result statistics of satisfactory mix designs if available from prior projects. Comply with CBC Section 1905.3.
 - b. Submit test results of trial batches prepared for this project. Comply with CBC Section 1905.3.
 - c. Allow adequate time for review of submittals and adjustments to comply with the Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Materials shall conform to the following:

1. Portland Cement: ASTM C150, Type II or V.
2. Aggregate: Comply with ASTM C33. Aggregate shall consist of fine aggregate, with or without coarse aggregate, with a minimum size of 1-inch, free of clay, organics, and other deleterious materials. Less than 10 percent by weight shall pass the No. 200 sieve, and material passing the No. 40 sieve shall be nonplastic as determined in accordance with ASTM D4318.
3. Water: Potable.
4. Fly Ash: ASTM C618, Class F unless otherwise approved.
5. Admixtures: Air entraining; ASTM C260. Air content limited to 6% unless demonstrated to avoid segregation. Provide a liquid admixture such as DaraFill manufactured by W.R. Grace when air contents from 15-35% are required.

2.02 MIXES

- A. Performance Requirements: The CLSM shall be proportioned to be a nonsegregating, free-flowing, self-consolidating, low-shrink slurry.
- B. Mix Design Requirements: The Contractor and its supplier shall determine the materials and proportions used to meet the requirements of the Specifications. The mix design shall be prepared for a range of aggregate gradations that are expected to be used.
- C. Strength: The unconfined compressive strength at 28 days shall be 150 psi minimum as per ASTM D4832.
- D. Flowability: The slump shall be 7 inches (± 1 inch) as per ASTM C143.
- E. Density: The density shall be between 115-145 lb/ft³.
- F. Minimum Cement Content: For compliance with Caltrans 185 lb/cy (110 kg/m³).

2.03 SOURCE QUALITY CONTROL

- A. Mix, transport, and place CLSM in accordance with the methods and procedures in ACI 304 and ASTM C94.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions: CLSM batching, mixing, and placing may be started if the weather conditions are favorably and when the air temperature is 34°F and rising. At the time of placement, the CLSM must have a temperature of at least 40°F. Mixing and placing shall stop when the air temperature is 38°F or less and falling.
- B. Subgrade on which CLSM is to be placed shall be free of disturbed or softened materials, debris, and water.

3.02 PREPARATION

- A. Protection: Take appropriate precautions to prevent pipe displacement and/or flotation.

3.03 CONSTRUCTION

- A. Special Techniques: Contain CLSM in trench sections using bulkheads or fill materials to confine the flow of material.
- B. CLSM shall be placed in lifts not exceeding 6 feet in height, with a time interval of not less than 1 hour between lifts.

3.04 FIELD QUALITY CONTROL

- A. Field Control Testing: Performed by the Contractor:
1. After completion of the trial mix work, and prior to CLSM placement operations, the Contractor shall prepare field trial mixes. The initial mix shall be based on the design mix. Additional trial mixes may be made by varying the proportions as may be required to produce a dense, homogenous material with good workability.
 2. Manufacture of the field trial mixes shall be accomplished utilizing the equipment that will be used on the job.
 3. Compressive strength: A set of six standard 6 inch x 12 inch cylinders will be cast for each mix.
 - a. Making, storing and initial cure of cylinders: ASTM C94 or C685. Provide site storage and initial cure, 16 hours minimum and 24 hours maximum.
 - b. Testing laboratory: Provided by Contractor.
 - c. Final cure and tests of cylinders: ASTM D4832. Testing laboratory will transport cylinders from site, cure, test and provide report. Test one specimen at 7 days, one at 14 days, one at 21 days, and two at 28 days. One specimen shall be held as a "spare" and may be used in the event of questionable results from one of the scheduled tests.
- B. Site Tests: Performed by the Engineer:
1. Test frequency: Each mix type placed, each day placed.
 2. Compressive strength: A set of four standard 6-inch x 12-inch cylinders will be cast for each mix and for 100 cubic yards or fraction thereof.
 - a. Making, storing and initial cure of cylinders: ASTM C94 or C685. Provide site storage and initial cure, 16 hours minimum and 24 hours maximum.
 - b. Testing laboratory: Provided by Owner.
 - c. Final cure and tests of cylinders: ASTM D4832. Testing laboratory will transport cylinders from site, cure, test and provide report. Test one specimen at 7 days, and two at 28 days. One specimen shall be held as a "spare" and may be used in the event of questionable results from one of the scheduled tests.
 3. Slump: Test will be performed on each 50 cubic yards or fraction thereof. Test each sample used for strength tests.
 - a. Testing: ASTM C143.
 - b. Results outside the limits indicate possible cause for rejection of concrete. The Engineer shall be the sole judge.

3.05 PROTECTION

- A. When backfilling against retaining walls or other below grade structures, protection shall be provided to the wall or structure from the lateral pressures exerted by the material.
- B. Protect facilities from bleed water. Make provisions for runoff of bleed water.
- C. Provide steel plates to span trenches and prevent traffic contact if necessary. No traffic or construction equipment shall be allowed on CLSM for at least 24 hours after placement, or until the material is hard enough to prevent rutting or damage.

END OF SECTION

SECTION 02200
SITE PREPARATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Site preparation shall consist of all clearing, grubbing, stripping, (demolition), and related work necessary to prepare the project site for construction operations.
 - 2. No open burning of debris, lumber, or other scrap will be permitted.
 - 3. Trees and vegetation to be left standing shall be protected from damage incident to site preparation and construction operations by the erection of barriers or by such other means as the circumstances require.

- B. Related Sections:
 - 1. Section 01140: Environmental Protection
 - 2. Section 02050: Demolition
 - 2. Section 02300: Earthwork

PART 2 - PRODUCTS

Not used

PART 3 - EXECUTION

3.01 DEMOLITION

- A. Demolish and remove any fences, posts, poles, or other structures from within the project site, areas to be cut or areas to receive fill, and pipeline alignments.

3.02 CLEARING

- A. Clearing shall consist of the felling, trimming and cutting of trees, and the removal of downed timber, shrubs, grasses, debris and rubble from the project site which will obstruct or otherwise impede construction operations.

3.03 GRUBBING

- A. Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the construction area. This material, together with logs and other organic debris, shall be excavated and removed to a depth of not less than 18 inches below the original surface level of the ground in areas indicated as construction areas under this Contract, such as areas for structures, pavement, fills. Depressions made by grubbing shall be filled with structural backfill material and compacted to make the surface conform with the original adjacent surface of the ground, unless further excavation is required. Grub borrow areas to the extent necessary to obtain material free of stumps and roots.

3.04 STRIPPING

- A. Strip the upper 6 inches of soil containing vegetation and root matter from all areas to receive fill and from all areas to be excavated.

3.05 DISPOSAL

- A. Felled Trees and Downed Timber: Cut up and stockpile where directed by the Engineer.
- B. Strippings: Stockpile stripped material and use it to restore the site.
- C. Dispose of remaining vegetation and debris in accordance with Section 01140.

END OF SECTION

SECTION 02300

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Perform all excavation, shoring, dewatering, backfilling and, compaction for the construction of the work. 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.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM).
- B. State of California, Department of Transportation, Standard Specifications May 2006 (Standard Specifications).
- C. State of California, Department of Transportation, Manual of Test (California Test).

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit the following under the Product Review category.
 - 1. Sheeting and Shoring Plan: Comply with paragraph 1.08 below, Section 01040, paragraph 1.14, and the requirements indicated on the Drawings.
 - 2. Potholing Report as described in Paragraph 3.02.
 - 3. Samples and Test Results: Furnish, without additional cost to the Owner, such quantities of import materials as may be required by the Engineer for test purposes. Cooperate with the Engineer and furnish necessary facilities for sampling and testing of all materials and workmanship. Submit test results for import materials. Tests shall be performed within 60 days of the submission. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the Engineer, or used in the construction work until it has been inspected in the field by the Engineer.

1.04 QUALITY ASSURANCE

- A. Source Quality Control: Test import materials proposed for use to demonstrate that the materials conform to the specified requirements. Tests shall be performed by an independent testing laboratory.
- B. Field Quality Control:
 - 1. The Owner will:
 - a. Review materials proposed for use.
 - b. Observe foundations, site grading and borrow operations.
 - c. Observe placement and compaction of fill.
 - d. Test soils during placement of fill.

2. Contractor shall excavate holes for in-place soil sampling. Contractor shall be responsible for costs of additional inspection and re-testing resulting from non-compliance.
3. Contractor shall:
 - a. Excavate holes for in-place soil sampling.
 - b. Test soils during placement of fill to verify conformance with material requirements defined herein.
 - c. Be responsible for costs of additional inspection and re-testing resulting from non-compliance.

C. Testing Methods:

1. Durability Index: Manual of Test, State of California, Department of Transportation.
2. Specific Gravity: ASTM D854
3. Laboratory Compaction: ASTM D1557, Method A or C.
4. In-place Density: ASTM D1556 or ASTM D2922.
5. Particle Size Analysis of Soils: ASTM D422.
6. Plastic Limit and Plasticity Index: ASTM D4318.
7. Soil Classification: ASTM D2487.
8. In-place Moisture Content: ASTM D3017.

D. Definitions

1. Relative Compaction: In-place density divided by the maximum dry density laboratory compaction expressed as percentage.
2. Rock Excavation: Excavation of solid rock that, in the opinion of the Engineer, requires for its removal drilling and blasting, wedging, sledging, barring or breaking up with power-operated tools. The term "Rock Excavation" indicates a method of removal and not a geological formation.

1.05 EXPLOSIVES

- A. Do not use explosives unless specifically authorized, in writing, by the Engineer.

1.06 SUBSURFACE INVESTIGATIONS

- A. Geotechnical investigations for design purposes for this project were made for the Project by Geo-Logic Associates in a report dated June 22nd, 2016. This report is available at the Owner's office.
- B. The bidders may make additional subsurface investigations at the site prior to the bidding of the project. Prior to making any drillings or excavations, the bidder shall secure permission from the Owner, and property owners if on private property.

1.07 REFERENCE SPECIFICATIONS

- A. Whenever the words "Standard Specifications" are referred to, the reference is to the State of California, Department of Transportation, Standard Specifications, latest edition.

1.08 ADDITIONAL SAFETY RESPONSIBILITIES

- A. The Contractor shall select, install and maintain shoring, sheeting, bracing, and sloping as necessary to maintain safe excavations. The Contractor shall be responsible for ensuring such measures: (1) comply fully with 29 CFR Part 1926 OSHA Subpart P Excavations and Trenches requirements, (2) provide necessary support to the sides of excavations, (3) provide safe access to the Engineer's sampling and testing within the excavation, (4) provide safe access for backfill, compaction, and compaction testing, and (5) otherwise maintain excavations in a safe manner that shall not endanger property, life, health, or the project schedule. All earthwork shall be performed in strict accordance with applicable law, including local ordinances, applicable OSHA, CalOSHA, California Civil Code, and California Department of Industrial Safety requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Crushed Rock: Class 2, 3/4-inch maximum aggregate base, Standard Specifications Section 26.
- B. Pipe Bedding and Backfill Materials:
 - 1. Class 2, 3/4-inch maximum aggregate base, Standard Specifications Section 26. For the purposes of this project, Class I bedding material requirements and Class II bedding material requirements, as shown on the Drawings, shall be met by Class 2 bedding.
 - 2. Soil Cement Bedding: Standard Specifications, Paragraph 19-3.025C.
- C. Imported Backfill: Imported nonexpansive soil with liquid limit no greater than 40% and a plasticity index no greater than 15%, free from clods or rocks larger than 4 inches in greatest dimension, contain no more than 15 percent larger than 2.5 inches and free from organic material.
- D. Native Backfill: Native soil prepared as necessary to be free from clods or rocks larger than 2 inches in greatest dimension, and free from organic material.
- E. Engineered Fill: Class 2, 3/4-inch maximum aggregate base, Standard Specifications Section 26.
- F. Water: The water used shall be reasonably free of objectionable quantities of silt, oil, organic matter, alkali, salts and other impurities. Water quality must be acceptable to the Engineer.
- G. Aggregate base shall conform to the applicable requirements of the Standard Specifications Section 26, for Class 2 aggregate base. The aggregate base shall conform to that specified for the 3/4 inch maximum, unless otherwise indicated. Paragraphs 26-1.06 and 26-1.07 are not applicable.
- H. Warning Tape: 3-inch-wide, inert, fade-resistant plastic film resistant to acids, alkalis, and other components likely to be encountered in soil.
- I. Detection Tape: Plastic metallic type consisting of a blue color coded polyethylene or melinex film, a solid core aluminum foil detection layer and other layers as required. The tape shall be resistant to acids, alkalines and other components likely

to be encountered in soils. It shall be designed for both conductive and inductive locating procedures.

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.
 - 1. It should be presumed that if groundwater is experienced, groundwater dewatering shall be required. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering all excavations. At all times have on the project sufficient pumping equipment for immediate use, including standby pumps for use in case other pumps become inoperable.
 - 2. Provide a sufficient number of pumps so as to hold the groundwater level at an elevation of not less than 1 foot below the lowest elevation of the pipe, duct or other material to be placed.
 - 3. Dispose of water in such a manner as to cause no injury or nuisance to public or private property, or be a menace to the public health.
 - 4. The dewatering operation shall be continuous, so that the excavated areas shall be kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.
 - 5. Continue dewatering during backfilling operations such that the groundwater is at least 1 foot below the level of the compaction effort at all times. No compaction of saturated materials will be allowed.
 - 6. Dewatering devices must be adequately filtered to prevent the removal of fines from the soil.
 - 7. The Contractor shall be responsible for any damage to the foundations or any other parts of existing structures or of the new work caused by failure of any part of the Contractor's protective works. After temporary protective works are no longer needed for dewatering purposes, they shall be removed by the Contractor.
 - 8. If pumping is required on a 24-hour basis, requiring engine drives, then engines shall be equipped in a manner to keep noise to a minimum. Refer to Section 01140 for noise control requirements.
 - 9. Prevent disposal of sediments from the soils to adjacent lands or waterways by employing whatever methods are necessary, including settling basins.
- 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: The known existing utilities and pipelines are shown on the Drawings in their approximate location. The Contractor shall exercise care in avoiding damage to all utilities as he will be held responsible for their repair if damaged. There is no guarantee that all utilities or obstructions are shown, or that locations indicated are accurate. Utilities are piping, conduits, wire, cable, ducts, manholes, pull boxes and the like, located at the project site.

- B. Check on Locations (Potholing): Contact all affected utility owners and request them to locate their respective utilities prior to the start of "potholing" procedures. The utility owner shall be given 7 days written notice prior to commencing potholing. If a utility owner is not equipped to locate its utility, the Contractor shall locate it.
- C. Clearly paint the location of all affected utility underground pipes, conduits and other utilities on the pavement or identify the location with suitable markers if not on pavement. In addition to the location of metallic pipes and conduits, non-metallic pipe, ducts and conduits shall also be similarly located using surface indicators and detection tape if present and shall then be similarly marked.
- D. After the utility survey is completed, commence "potholing" to determine the actual location and elevation of all utilities where crossings, interferences, or connections to new pipelines or other facilities are shown on the Drawings, marked by the utility companies, or indicated by surface signs. Prior to the preparation of piping shop drawings, or the excavating for any new pipelines or structures, the Contractor shall locate and uncover these existing utilities to a point 1 foot below the utility. Submit a report identifying each underground utility and its depth and location. Any variation in the actual elevations and the indicated elevations shall be brought to the Engineer's attention.
- E. Excavations around underground electrical ducts and conduits shall be performed using extreme caution to prevent injury to workmen or damage to electrical ducts or conduits. Similar precautions shall be exercised around gas lines, telephone and television cables.

Excavations shall have a surface dimension of no more than 18" x 18". Air spades and vacuum excavators shall be used to limit the size of the excavation and damage to adjacent facilities. Backfill after completing potholing. In existing streets pave with 1 inch of cold mix asphalt concrete.

- F. Interferences: If interferences occur at locations other than shown on the Drawings, the Contractor shall notify the Engineer, and a method for correcting said interferences shall be supplied by the Engineer. Payment for interferences that are not shown on the plans, nor which may be inferred from surface indications, shall be in accordance with the provisions of the General Conditions. If the Contractor does not expose all required utilities prior to shop drawing preparation, he shall not be entitled to additional compensation for work necessary to avoid interferences, nor for repair to damaged utilities.
- G. Any necessary relocations of utilities, whether shown on the Drawings or not, shall be coordinated with the affected utility. The Contractor shall perform the relocation only if instructed to do so in writing from the utility and the Engineer.
- H. Shutdowns: Planned utility service shutdowns shall be accomplished during period of minimum use. In some cases this may require night or weekend work. Such work shall be at no additional cost to the Owner. Program work so that service will be restored in the minimum possible time, and shall cooperate with the utility companies in reducing shutdowns of utility systems to a minimum.
 - 1. Disconnections: No utility shall be disconnected without prior written approval from the utility owner. When it is necessary to disconnect a utility, the Contractor shall give the utility owner not less than 72 hours notice when

requesting written approval. The Contractor shall program his work so that service will be restored in the minimum possible time.

- I. Overhead Facilities: There may be existing overhead electric and telephone transmission lines at the site. These overhead utilities are not shown on the Drawings. 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. The Contractor shall be required to comply with the applicable provisions of the California Construction Safety Orders when working anywhere on this project.

3.03 GENERAL CONSTRUCTION REQUIREMENTS

- A. Site Access: Access to the site will be over public and private roads. Exercise care in the use of such roads and repair at own expense any damage thereto caused by Contractor's operations. Such repair shall be to the satisfaction of the Owner or agency having jurisdiction over the road. Take whatever means are necessary to prevent tracking of mud onto existing roads and shall keep roads free of debris.
- B. Barriers: Barriers shall be placed 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. Lights shall also be placed along excavations from sunset each day to sunrise of the next day until such excavation is entirely restored.
- C. Demolition of Pavement: Where trenching or excavation occurs in paved areas, the pavement shall be scored and broken ahead of the trenching or excavation operation. The extent of paving removed shall be limited to the minimum necessary for the excavation.
- D. Dust Control: Take proper and efficient steps to control dust.
- E. Permits: Refer to General Conditions.
- F. Storage of Materials: Neatly place excavated materials far enough from the excavation to prevent stability problems. Keep the materials shaped so as to cause the least possible interference with facilities operations and drainage.
- G. Existing Facilities: Maintain access to existing facilities to permit continued operation. Maintain access for fire fighting equipment and to fire hydrants.

3.04 COMPACTION

- A. Add water to the backfill material or dry the material as necessary to obtain moisture content within 2% of optimum. Employ such means as may be necessary to secure a uniform moisture content throughout the material of each layer being compacted.
- B. After the material has been moisture conditioned, compact it with compaction equipment appropriate for the use to achieve specified compaction.
- C. If the backfill material becomes saturated from rains or any other source because it was not compacted to the specified density or was not backfilled and compacted to surface grade, through negligence or otherwise, remove the faulty material and

replace it with suitable material compacted to the specified density. No additional payment will be made for doing such work or removal and replacement.

- D. Compaction of embankment and backfill materials by flooding, ponding or jetting is not permitted.
- E. When densities of compacted materials do not meet the requirements, remove and/or recompact the material until the requirements are met. The Contractor will be backcharged the cost of retesting all failing tests, including the initial retest. Such backcharges will be deducted from the Contractor's Progress Payments.
- F. Material Requirements
 - 1. Pipe Bedding Material: Compact to a minimum 95 percent of maximum density, in accordance with AASHTO T-99 unless otherwise specified or shown on the Drawings.
 - 2. Pipe Zone Material: Compact by hand methods under the haunches of the pipe and in areas not accessible to mechanical tampers unless otherwise specified or shown on the Drawings.
 - 3. Imported Backfill: Compact to a minimum 95 percent of maximum density, in accordance with AASHTO T-99 unless otherwise specified or shown on the Drawings.
 - 4. Native Backfill: Compact to a minimum 85 percent of maximum density, in accordance with AASHTO T-99 unless otherwise specified or shown on the Drawings.
 - 5. Foundation Stabilization: Compact to a minimum 95 percent of maximum density, in accordance with AASHTO T-99 unless otherwise specified or shown on the Drawings.
 - 6. Engineered fill: Compact in accordance with the Geotechnical Report/Engineer unless otherwise specified or shown on the Drawings.
 - 7. Landscape Fill: Compact to a minimum 85 percent of maximum density, in accordance with AASHTO T-99 unless otherwise specified or shown on the Drawings.
 - 8. Impervious Material: Compact to a minimum 90 percent of maximum density, in accordance with AASHTO T-99 unless otherwise specified or shown on the Drawings.
- G. Testing Frequency:
 - a. Trench Backfill: Test every 200 feet of trench.
 - b. Earthwork: Test every 500 square feet for each 2 feet of fill.
 - c. Engineered Fill:
 - 1) Sub-base: Test every 200 square feet.
 - 2) Base:
 - i. Test every 200 square feet of building footprint, with no less than 2 tests per structure.
 - ii. Test every 200 cubic yards of material placed within 10 feet around the building.

3.05 NOT USED

3.06 TRENCH EXCAVATION

- A. Excavation for pipe and other utilities such as electric conduit or duct banks shall be in open cut. The trench shall be as wide as necessary for sheeting and bracing and the proper performance of the work up to the maximum width permitted by the typical cross-sections shown on the Drawings. The sides of the trenches shall be vertical in paved areas. The bottom of the trench shall be constructed to the grades and shapes indicated on the Drawings. Should the Contractor desire to use other equivalent methods, he shall submit his method of construction to the Engineer for favorable review prior to its use.
- B. Take care not to overexcavate. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe or conduit at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints, and as hereinafter specified. Dig bell holes and depressions for joints after the trench bottom has been graded. In order that the pipe rest on the bedding for as nearly its full length as practicable, bell holes and depressions shall be only of such length, depth and width as required for properly making the joint. Remove stones as necessary to avoid point bearing.
- C. Backfill and compact overexcavations in accordance with the requirements of Section 3.04 with bedding material. There shall be no additional payment to the Contractor for overexcavations not directed by the Engineer. Remove unsatisfactory material encountered below the grades shown as directed by the Engineer and replace with bedding material. Payment for removal and replacement of such unsatisfactory material directed by the Engineer shall be made in accordance with the provisions of the General Conditions.
- D. Grade trenches so that they are uniformly sloped between the pipe elevations shown on the Drawings. If no elevations are shown on the Drawings, provide 3 feet of minimum cover. Comply with the minimum and maximum trench widths shown on the Drawings. Notify the Engineer if the trench width exceeds the maximum allowable width for any reason.
- E. For all piping or conduits to be placed in any excavated and backfilled area, such as at manholes or for building connections, the engineered fill shall be first compacted to a level at least 3 feet from the top of the piping or conduit elevation and then retrenched to pipe grade.
- F. Provide ladders for access to the trench by construction and inspection personnel.

3.07 EXCAVATION FOR STRUCTURES

- A. All excavation for structures shall be done to the dimensions and levels indicated on the Drawings or specified herein. Excavate 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. Take care 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 other material approved by the Engineer in a manner that 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: Notify the Engineer when excavation for the structure is complete. No forms, reinforcing steel, concrete, or precast structure shall be placed until the excavation has been inspected by the Engineer.
- D. Where unsatisfactory material is encountered below the grades shown for structural excavations, it shall be removed and replaced with crushed rock as directed by the Engineer and compacted. Payment for removal and replacement of such unsatisfactory material directed by the Engineer shall be made in accordance with the provisions of the General Conditions.

3.08 SUPPORT OF EXCAVATIONS

- A. Adequately support excavation for trenches and structures to meet all applicable requirements in the current rules, orders and regulations. 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. Keep vehicles, equipment, and materials far enough from the excavation to prevent instability.
- B. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from the high groundwater table and the nature of the soil excavated. Attention is directed to Section 832 of the Civil Code of the State of California relating to lateral subadjacent supports, and wherever structures or improvements adjacent to the excavation may be damaged by such excavation, the Contractor shall comply with this law.
- C. 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.
- D. Refer to the Drawings for criteria to support excavations above rock.

3.09 TRENCH BACKFILL

- A. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings and compacted to the degree specified on the Drawings. Place bedding and backfill materials in horizontal lifts not to exceed 6 inches in thickness measured before compaction. The difference in level on either side of a pipe shall not to exceed 4 inches.
- B. Backfill material shall not be placed over the pipe or conduit until after the joints have been completed and inspected by the Engineer.
- C. It shall be incumbent upon the Contractor to protect the pipe or conduit from damage during the construction period. It shall be his responsibility to repair broken or damaged pipe at no extra cost to the Owner. Carefully place backfill around and

over the pipe and do not allow it to fall directly upon the pipe. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers and other machines that will not injure or disturb the pipe.

- D. Do not allow construction traffic nor highway traffic over the pipe trench until the trench backfill has been brought back even with existing adjacent grade.

3.10 ENGINEERED FILL

- A. Crushed Rock Subgrade: Place a layer of rock, compacted in accordance with the requirements of Section 3.04, under structures to the lines, grades and minimum thicknesses shown on the Drawings. Unless shown specifically otherwise in the Drawings, do not use rock as backfill above the elevation of the highest base slab of the structure.
- B. Backfill Adjacent to Structures:
 - 1. Backfill shall be engineered fill compacted in accordance with the requirements of Section 3.04 unless otherwise specified or shown on the Drawings. Native backfill may be allowed in locations where backfill is below unpaved surfaces, and it can be compacted to 95%.
 - 2. Do not place backfill against structures until the concrete has been patched and cured.
 - 3. Do not place backfill against structures until at least 28 days after the concrete was placed, or until the concrete has achieved a strength of at least 2,500 psi, whichever is earlier. Concrete strength shall be demonstrated by field cured cylinders tested at the Contractor's cost, prepared and tested in accordance with ASTM C31 and ASTM C39.
 - 4. Do not place backfill against hydraulic structures until the structure has passed the specified leakage tests.
 - 5. 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.

3.11 NOT USED

3.12 NOT USED

3.13 FINISH GRADING

- A. Except where shown otherwise in the Drawings, restore the finish grade to the original contours and to the original drainage patterns. Grade surfaces to drain away from structures. The finished surfaces shall be smooth and compacted.

3.14 DISPOSAL OF EXCAVATED MATERIAL

- A. Dispose of unsuitable material or excavated material in excess of that needed for backfill or fill offsite in accordance with the requirements of Section 01140.

END OF SECTION

SECTION 02400

WATER PIPING AND APPURTENANCES

PART 1 - GENERAL

1.01 SUMMARY

- A. The work of this section consists of furnishing and installing water system piping and appurtenances.

1.02 REFERENCE SPECIFICATIONS

- A. American Association of State Highway and Transportation Officials (AASHTO)
- B. American National Standards Institute (ANSI)
- C. American Society of Mechanical Engineers (ASME)
- D. American Society for Testing and Materials (ASTM)
- E. American Water Works Association (AWWA)
- F. National Science Foundation (NSF 61)

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Layouts and Schematics: Submit detailed installation drawings of all piping. Schematics may be submitted for piping 4 inches and smaller, and as called for elsewhere in these specifications and drawings.. The Drawings and schematics shall include: pipe support locations and types, fittings, valves, other appurtenances. (Product Review).
- C. Potholing report.
- D. Manufacturer's literature and certificates of compliance with the reference standards for pipe, fittings, and couplings.
- E. Manufacturer's installation instructions or guide.
- F. Leakage Testing Plan

1.04 PRODUCT HANDLING

- A. Delivery: Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. Engineer will reject damaged pipe on site. Contractor shall replace damaged pipe at no additional expense to the Government.
- B. Storage: Do not store materials directly on the ground. Adequately support piping to prevent warpage. Use protective covers where pipe may be damaged by direct sunlight.

1.05 POTHOLING

- A. Do not prepare any shop drawings for, or make final order for, or design any pipe materials for any particular section of pipeline until all utilities in that section of pipeline have been exposed. If interferences are found in any particular section of pipeline, do not prepare any shop drawings for, or make final order for, or design any pipe materials for that particular section of pipeline until the pipeline alignment has been modified by the Engineer to eliminate all such interferences.

1.06 PIPE SUPPORTS

- A. General:
 - 1. Contractor shall design, locate, and install all pipe supports in accordance with this specification and Drawing G-3, General Note 28. Furthermore, Contractors shall provide a shop drawing for Engineer Favorable Review, showing pipe support types and pipe support locations.
 - 2. Pipe supports are not shown. Piping 2-inches and larger and all piping for hazardous chemicals shall be supported with pipe supports designed to resist seismic loads. Piping smaller than 2 inches with non-hazardous contents may be supported with non-seismic resistant supports. Note that the design drawings provide two representative pipe supports for Contractor consideration in their design. These two representative pipe supports do not relieve the Contractor of responsibility of designing, locating, and installing pipe supports as specified above.
 - 3. Pipe support types and spacing shall be in accordance with the Manufacturer's Standardization Society (MSS) Standard Practice No. SP 58 and No. SP 69, except as superseded by the requirements of these Specifications..
- B. Pipe Support System Design:
 - 1. Design Loads: Pipe suspension shall prevent excessive stress or excessive variation in supporting force while system is in operation. Pipe supports shall support the combined weight of the pipe, fittings, appurtenances, and contents. In addition, the pipe shall be anchored to resist internal pressure forces tending to separate any unrestrained joint at pressures 1-½ times the maximum working pressure for the applicable service.
 - 2. Seismic Loads: Design the pipe supports in accordance with 2019 CBC and Drawing G-3, General Note 28.
 - 3. Location: All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at all nonrigid joints, and where otherwise shown. Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment.
- C. Piping penetrations through concrete walls and slabs are considered to resist seismic loading, provided penetrations for pipes 3 inches in diameter and larger are complete with a wall flange.
- D. Anchors: Provide and install Anchors for connecting pipe supports to concrete pads.

PART 2 - PRODUCTS

2.01 PIPE SCHEDULE

<u>Process ID</u>	<u>Service</u>	<u>Buried/Exposed</u>	<u>Material (1,2,3)</u>
W	WATER, >=4-IN	BURIED	PVC C900
W	WATER, >=4-IN	EXPOSED	DI
W	WATER, <4-IN	BURIED/EXPOSED	PVC Schedule 80
S	WATER, <4-IN	BURIED/EXPOSED	COPPER
D	SAMPLE DRAIN	BURIED/EXPOSED	PVC (3)
AIR	COMPRESSED AIR	BURIED/EXPOSED	COPPER

1. CONTRACTOR SHALL INSTALL ANY NECESSARY FITTINGS, COUPLINGS, AND APPURTENANCES TO CONNECT DISSIMILAR PIPE MATERIALS.
2. CONTRACTOR SHALL INSTALL ANY NECESSARY FITTINGS, COUPLINGS, AND APPURTENANCES TO CONNECT PIPING TO VENDOR-SUPPLIED PACKAGE SYSTEMS INCLUDING THE PACKAGE PUMPING MANHOLE.
3. SAMPLE DRAIN MATERIAL SHALL BE IN ACCORDANCE WITH EAST PALO ALTO SANITARY DISTRICT STANDARDS.

2.02 GENERAL

- A. Pipe and valve sizes are nominal inside diameter unless otherwise noted.
- B. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.
- C. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage and bacteriological tests as specified hereinafter.
- D. Buried nuts and bolts for flanges and couplings shall be Type 304 stainless steel unless otherwise specifically specified herein.
- E. Fusion Epoxy Coating: Materials and application shall be in accordance with AWWA C213, except application shall be by the fluid bed method only unless the greatest dimension of the article to be coated exceeds 10 feet, in which case electrostatic spray method may be used.

2.03 DUCTILE IRON PIPING, FITTINGS, AND JOINTS

- A. Flanged Pipe: a. Flanged Pipe: AWWA C115 including Appendix A, minimum thickness Class 53
- B. Flanges: Ductile iron, plain faced, AWWA C115. Submit certification that flanges comply with AWWA C115.
- C. Fittings: Flanged: Ductile iron, AWWA C110 or AWWA C153.
- D. Bell and Spigot Pipe: AWWA C151. Pressure Class 250.
- E. Joints: Push-on or mechanical, AWWA C111 as modified, except where flanged joints are shown on the Drawings or where making connections to valves.
 1. Gaskets: Unless otherwise specified, gaskets shall be SBR OR NBR (Nitril or Buna-N) approve for potable water system..
 2. Restrained Joints: provide restrained joints capable of deflection after the restraint is installed. Joints shall not separate under an internal pressure of

- 250 psi. TR-FLEX by United States Pipe & Foundry Company; Mega-lug or Mega-Flange by EBAA Iron; equivalent by American Cast Iron Pipe Company; or approved equal.
3. Buried Tee-Head Bolts and Nuts for Mechanical Joints: Ductile iron or cor-ten or Type 304 stainless steel.
 4. Buried bolts and nuts for flanged joints shall be Type 304 stainless steel
 5. Provide insulating flanges with two cathodic test stations for buried ductile iron to steel connections
 6. Contractor shall provide restrained joint when transitioning from Ductile Iron to PVC.
- F. Mechanical Joint: AWWA C111-90. Stuffing-box type with sealing gasket, follower gland, tee-head bolts and hexagonal nuts. Bolts and nuts shall be the high-strength, low-alloy steel type for enhanced corrosion resistance.
- G. Adapters for Flanged Fittings: Manufactured flange coupling adapters or threaded flanges on thickness Class 53 pipe. Flange bolts and nuts shall be high-strength, low-alloy steel type for enhanced corrosion resistance for above ground bolts and type 304 stainless steel for buried bolts.
- H. Fittings: Ductile Iron flanged fittings or mechanical joint fittings with restraint system. Restraint system shall be US Pipe TR-Flex or EBAA Iron Mega-Flange 'Mega- Lug' restraint system in accordance with AWWA C153.
- I. Lining: Provide standard thickness cement mortar lining for pipe and fittings, AWWA C104.
- J. Coating: Exposed cement mortar lined pipe shall be coated per Section 09960 and shall be factory primed prior to shipment with primer or first coat which is compatible with selected field paint system. Buried cement mortar lined pipe shall receive asphalt coating per AWWA C151.
- K. Protection for buried pipe: Asphalt dip per AWWA C151, and 8-mil thick polyethylene encasement, AWWA C105, black. Polyethylene encasement, black, AWWA C105. Single-wrap pipe, double-wrap flanged fittings, mechanical joints, or other appurtenances with significantly different outside diameters from the pipe. Tape to seal seams and over laps at least 2 inches wide.
- L. Gaskets: Flanged: Full face, 1/8-inch-thick, AWWA C115, Appendix A.
- M. Flange Bolts: AWWA C115, Appendix A.
- N. Pipe Taps:
1. Direct threaded taps are not acceptable. Pipe branch line connections shall be made using service saddles, by using reducing flanges on tees, or by tapping blind flanges on tees.
 2. Service Saddles:
 - a. Materials: Ductile-iron saddle with bronze or 316 stainless steel straps and hardware.
 - b. Type:
 - 1) For ductile iron pipe 4 inches and less, single strap saddles may be used. For pipe greater than 4-inch, double strap saddles shall be used.
 - 2) Or stainless steel full circumference band
 - c. Manufacturers: Smith-Blair Model 311 or 313; R. H. Baker and Company Series 180-0; equivalent Romac or equal

2.04 PVC PIPE, FITTINGS, AND JOINTS 4-IN AND GREATER

- A. Pipe: Polyvinyl chloride pressure pipe, cast iron pipe outside dimensions. Pipe shall be UL listed or Factory Mutual Approved. Pipe shall be NSF-61 approved for potable water use.
 - 1. 4-inch through 12-inch: AWWA C900
- B. Pressure Class 235 (DR18)
- C. Joints: AWWA C900/C905, Restrained joints: Bell and spigot (push-on) gasketed, or mechanical joints; both using ductile iron clamp-on restraining devices.
 - 1. Restraining devices: Ductile iron with ductile iron or cor-ten rods and bolts. Pressure rating of at least 235 psi. Series 1900 by EBBA Iron; equivalent by Uni-Flange; or equal for bell and spigot joints. Series 19MJ00 by EBBA Iron; equivalent by Uni-Flange; or equal for mechanical joints for pipes up to 12-inch diameter. Series 2000PV Megalug by EBAA, equivalent by Uni-Flange; or equal for mechanical joints for pipes greater than 12-inch diameter to 36-inch diameter.
- D. Gaskets: AWWA C900/C905: Styrene Butadiene Rubber (SBR). Submit two sample gaskets of each gasket type with an explanation of the markings
- E. Fittings: AWWA C900/C905: Push-on cast iron or mechanical joint, AWWA C110, with hubs cast and/or ground as required for pipe furnished. Coating and lining to be as described for ductile iron fittings below. All rods and nuts shall be stainless steel.
- F. Protection: Polyethylene encasement, AWWA C105, black. Double wrap flanged fittings, mechanical joints, or other appurtenances with significantly different outside diameters from the pipe. Tape to seal seams and overlaps shall be plastic adhesive tape at least 4 mils thick and at least 2 inches wide.

2.05 PVC PIPE, FITTINGS, AND JOINTS, LESS THAN 4-INCH

- A. Pipe: PVC Schedule 80, gray, normal impact; ASTM D1785, Type 12454B. Materials shall bear NSF approval for use in potable water systems.
- B. Joints: Solvent weld, except flanged or threaded shall be permitted where required at equipment connections and where required on the Drawings. Use Military Specification T-27730A tape for threaded joints.
- C. Fittings: PVC Schedule 80, of same material as pipe; ASTM D2467. Provide socket fittings unless indicated otherwise on the Drawings.
- D. Solvent Cement: ASTM D2564; Product shall meet NSF 61 approval for use in potable water systems and be compatible with 11% sodium hypochlorite addition.
- E. Pipe Cleaner: As recommended by the pipe manufacturer for the schedule and size to be joined.

2.06 NOT USED

2.07 COPPER PIPE

- A. Pipe: Copper, ASTM B88.
 - 1. Buried: Type K (soft drawn).

2. Exposed: Type L (hard drawn).
- B. Joints:
1. Buried: Soldered or flared.
 2. Exposed: Soldered.
- C. Solder:
1. ASTM B32, Alloy Grade E or HB. Solder and flux shall contain less than 0.2% lead.
- D. Fittings:
1. Soldered: Wrought copper, ANSI B16.22; or cast bronze, ANSI B16.18.
 2. Flared: AWWA C800 and ANSI B16.26

2.08 PIPE COUPLINGS

- A. General: For typical pipe joints refer to pipe material specifications. Other joint devices shall be furnished where called for as specified below. Double-wrap with 8-mil polyethylene encasement per paragraph 2.2.G, and AWWA C105. Tape the edges of the encasement with PVC tape.
- B. Flexible Couplings and Flange Coupling Adaptors:
1. Sleeve: Cast iron or fabricated steel.
 2. Followers: Cast iron, ductile iron, or steel.
 3. Sleeve Bolts: ASTM A325, Type 3; malleable iron; or equivalent.
 4. Coating: Fusion epoxy line and coat sleeve and followers. Double-wrap per paragraph under galvanized steel pipe subsection above.
 5. Pressure Rating: 250 psi.
 6. Buried Flexible Coupling Sleeve: Long barrel
 7. Manufacturers:
 - a. Flexible Couplings:
 - 1) Connecting pipe with identical outside diameters: Smith-Blair 411 or 431, Dresser Style 38 or 53, or approved equal.
 - 2) Connecting pipe with slightly different outside diameters: Smith-Blair 413 or R 441, Dresser Style 162, or approved equal.
 - b. Flange Coupling Adaptors:
 - 1) Connecting new pipe or new pipe to existing non-ferrous pipe: Smith- Blair 912 or 913, Dresser Style 127 or 128, or approved equal.
 - 2) Connecting new pipe to existing ferrous pipe: Insulating flange coupling adaptor with insulating boot: Smith-Blair 932 or 933, or approved equal.
 8. Gaskets: Oil and grease-resistant; Smith-Blair Grade 60; or approved equal.
 9. Joint Restraint: Provide joint harnesses (tie rod lug or attachment plate assemblies) across flexible couplings and flange coupling adaptors. For flanged coupling adaptors, anchor studs may be substituted for the harnesses on pipe up to 12-inch. Design restraint in accordance with AWWA M-11 for 250 psi, if sizes of the rods are not indicated on the Drawings. Double wrap with 8mil polyethylene encasement, AWWA C105 and tape the edges of the encasement with PVC tape.
- C. Flexible Rubber Connectors:
1. Service: Water up to 12-inch-diameter:
 - a. Type: Molded, flowing arch, rubber expansion joints with full rubber flanges and retainer rings.

- b. Materials: Neoprene cover over nitrile tube, reinforced with nylon or polyester body and galvanized steel retainer rings. Water contact surfaces shall be certified per ANSI/NSF Standard 61.
 - c. Outdoor installations: Provide protective Hypalon cover.
 - d. Pressure Rating: 225 psi minimum.
 - e. Manufacturers: Proco Series 230, Garlock EZ-FLO Style 206; Holz Model 530; or equal.
- 2. Restraint: Provide galvanized steel control rod-compression sleeve assemblies for all flexible spools, except where pipelines cross structural expansion joints or where specifically omitted by note in the Drawings. Number and size of control rods shall be as required for the test pressure of the pipe system or 50 psi, whichever is greater.
 - 3. Provide full size intermediate metal pipe flanges where rubber spool connects with wafer style valves, lug style valves or other pipeline items that do not have full-face metal flanges.

2.09 PIPE SUPPORTS

- A. Manufacture and Design: Pipe supports shall to the maximum extent possible be standard factory fabricated units conforming to the typical supports and braces shown in the Drawings and as specified below. Where required support cannot be provided by standard factory fabricated units, and is not detailed on the Drawings, the Contractor shall provide special pipe supports. Supports shall be manufactured or special fabrications. Special fabrications shall be in conformance with Section 05500. Provide $\frac{3}{4}$ inch chamfer on corners of all support elements and file or grind smooth. Supports designated to allow axial pipe movement shall have smooth and even contact surfaces.
- B. Materials: All support systems shall be galvanized steel except that those that are submerged or that are located within a tank, channel, or other structure designed to hold water, below the top of surrounding walkway elevation or tank wall top, or otherwise called out on the Drawings, shall be Type 316 stainless steel. Trays for continuous support of plastic pipe or tubing shall be made of 20 gauge galvanized steel. Support stainless steel piping with stainless steel pipe supports.
- C. Insulation Protection Shields: Provide insulation protection shields at all pipe supports for insulated piping.
- D. Provide plastic caps with rounded corners on all exposed ends of channels.

2.10 APPURTENANCES

- A. Provide all necessary assembly bolts, washers and nuts, thrust blocks, supports, gaskets, flanges, and all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the piping, and devices included in or on the piping, equipment, and piping accessories.

PART 3 - EXECUTION

3.01 GENERAL

- A. Connections to existing potable water systems shall not occur until testing and disinfection is complete and all tests have passed per the Sections.

- B. Exercise great care to prevent injury to or scoring of the pipe lining and coating, as applicable, during handling, transportation or storage. Pipe shall not be stored on rough ground and rolling of the pipe on the coating will not be permitted. Repair any damaged pipe sections, specials, or fittings or replace at the direction of the Engineer.
- C. Inspect each pipe fitting, valve and accessory carefully before installation. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replaced at the direction of the Engineer.
- D. Place or erect all piping to accurate line and grade and backfill, support, hang, or brace against movement as specified or shown on the Drawings, or as required for proper installation. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.
- E. Use reducing fittings where any change in pipe size occurs. Bushings shall not be used, unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.
- F. Connections between ferrous and non-ferrous piping and accessories shall be made using a dielectric coupling, union, or flange.
- G. Where no grade elevations are shown on the Drawings, buried piping shall have at least 3 feet of cover.
- H. Provide each pipe with a firm, uniform bearing for its full length in the trench except at field joints. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work.
- I. Laying: After the trench bottom has been prepared for pipe installation in accordance with Section 02300, lay pipe with bells facing in the direction of laying, unless otherwise approved. On slopes exceeding 20 percent, bells shall face upgrade and laying shall proceed upgrade. Where connections are made with other lines, bells may face as needed.
- J. Whenever pipe laying is discontinued for short periods, or whenever work is stopped at the end of the day, close the open ends of the pipe with watertight plugs or bulkheads.
- K. Cleaning: As work progresses, clear the pipe interior of dirt and other debris by keeping swabs in the pipe and pulling them forward past each completed joint.
- L. Pipe Cutting: Cutting for closure or other reasons shall be done neatly by methods recommended by the manufacturer.
- M. Provide adequate trench pumping to ensure against groundwater contacting the inside of the pipeline at any time. Do not lower any pipe or fitting into a trench where groundwater is present and may enter the pipe. When necessary, pump the water from trenches and keep the trench dry until the joints have been completed and the open ends of the pipe have been closed with a watertight plug. Do not remove the plug until the trench has again been pumped dry.
- N. Keep new pipe sections clean and dry.
- O. Jointing: Clean gaskets, seats, and threads of foreign materials prior to joint assembly. Apply lubricant or sealing tape as recommended by the manufacturer.
 - 1. Push-On Joint: Carefully insert the spigot end into the bell to prevent entry of dirt and incorrect entry angle. With fork tool or crowbar, or by hand, make the joint to the insertion depth recommended by the manufacturer. When the

- selected pipe uses joints not designed for full depth insertion, prevent further closure of previously completed joints by restraining movement of the installed line while making succeeding joints.
2. Mechanical Joint: Carefully center the spigot in the bell and position the gasket evenly in the seat. Tighten bolts alternately to an even torque, causing the follower gland to expand the gasket uniformly for a tight seal.
 3. Plain End Jointing: Install factory made couplers in accordance with manufacturer's directions. Center the coupling collar over the joint and tighten bolts evenly.
 4. Threaded Joint: Cut threads accurately with sharp dies. Assemble screwed joints after applying Teflon tape to male threads. Once the joint has been tightened, backing off will not be permitted unless new tape is applied to the threads.
 5. Flanged End Jointing: Install correct gasket for flange faces used, and tighten bolts evenly.
- P. When making the connection between a new pipeline and an existing pipeline, or when repairing a damaged pipe, take the following extra precautions:
1. Excavation for connection shall be dry. Control of groundwater and excess water is the Contractor's responsibility.
 2. Clean the exterior of the existing pipeline of all dirt and debris, and spray or swab with a standard 5.25 percent or stronger chlorine solution (as specified) in the immediate vicinity of the work. Clean equipment and materials, including new pipe and fittings, to be used in making these connections of all dirt and debris and disinfect them. Allow at least 30 minutes contact time for disinfection before the chlorine solution is diluted or rinsed off. Provide sufficient trench pumps to prevent flooding of the trench.
 3. When an old line is opened, either by accident or by design, the excavation may be wet or badly contaminated from groundwater. Apply liberal quantities of standard chlorine solution or tablets to the open trench areas to lessen the danger from such pollution. Tablets are recommended because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation. Scatter liberally around and locate the tablets so that flow entering the work site will contact the disinfecting agent. Trench application should be done very carefully to avoid contact by skin and clothing with chlorine solution. Minimally, safety dictates wearing safety goggles and rain gear.
 4. When excavating a leaking or broken pipeline, "valve-off" the system gradually to less than watertightness. This is to prevent causing areas of zero pressure which would allow entry of foreign material. A flow should be maintained which is slightly less than trench pump capability. Once the break is exposed and cleaned to disallow site contamination, the valving can then be made watertight.

3.02 DUCTILE IRON PIPE INSTALLATION

- A. Buried pipe shall be installed in accordance with AWWA C600.
- B. Asphalt dip and wrap buried pipe with 8-mil polyethylene film in accordance with AWWA C105 and paragraph 2.2.G. Continuously seal seams and overlaps with tape. Seal circumferential overlaps with two turns of tape, half lapped. Gather excess polyethylene on top of pipe so as not to block backfill material from getting

under bottom of pipe. Use caution so as not to rip or cut the polyethylene film. Seal any rips or cuts in the film with tape.

- C. Wherever the pipeline crosses over or under a sewer main or house service lateral, center a standard length pipe, 18-foot minimum, on said sewer main or lateral so as to have the pipeline joints as far as possible away from the sewer. This may require field cutting of some pipe pieces.
- D. Flanged Joints: Flanged joints shall be made up tight with care being taken to avoid undue strain in the flanges, fittings, and other accessories. Bolt holes shall be aligned for each flanged joint. Bolts shall be full size for bolt holes; use of undersize bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Adjoining flange faces shall not be out of parallel to such a degree that the flanged joint cannot be made watertight without over-straining the flange. Replace any flanged pipe or fitting whose dimensions do not allow the making of a proper flanged joint as specified herein by one of proper dimensions. Clean flanges prior to making joints.
- E. Restrained Joints: Install in accordance with manufacturer's instructions. Pull slack out of joint after makeup. Provide one full pipe length on each side of restrained joints.
- F. Mechanical Joints: Deflections from a straight line or grade measured between extended centerlines of the connecting pipe shall not exceed the following:

Size of Pipe in Inches	Deflection per Linear Foot in Inches Mechanical Joint
4, 6	5/8
8, 10, 12	5/8

- G. If the required alignment necessitates deflection in excess of that specified above, provide either special bends or a sufficient number of shorter lengths of pipe to effect angular deflections within the limits specified.

3.03 POLYVINYL CHLORIDE PIPE INSTALLATION

- A. Deliver material to site at least 24 hours prior to installation to permit temperature equalization.
- B. Cut pipe ends squarely, ream and deburr inside and out.
- C. Solvent Weld Joints: Clean pipe ends and sockets and join in strict conformance with the pipe manufacturer's instructions. Make joints in accordance with ASTM D2855. Handle solvent cement joints and primers in accordance with ASTM F402.
- D. For threaded connections on PVC pipe, provide a short nipple, threaded at one end, with a socket fitting at the opposite end. Provide thread sealant in accordance with the pipe manufacturer's recommendations. Take care not to overtighten the connection.

3.04 COPPER PIPE

- A. Bends shall be made in a manner that does not crimp or flatten pipe.
- B. Dielectric unions shall be installed at connections with ferrous piping.
- C. Pipe shall have joints squarely cut clean, soldered joints shall be properly fluxed and heated before solder is placed in the joint. Joints must be driven up tight

before solder is added. Compression and flared joints shall be made up in accordance with the fitting manufacturer's installation instructions. Brazing shall be in accordance with ANSI B31.1.

- D. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- E. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
- F. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using steel sleeves and mechanical sleeve seals.
- G. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings, and floors, maintain the fire rated integrity.
- H. Install branch connections to mains using tee fittings in main with take-off out the bottom of the main, except for up-feed risers, which shall have take-off out the top of the main line.
- I. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, inline pump, and elsewhere as indicated. Install nipple and ball valve in blowdown connection of strainers 2 inches and larger.

3.05 COUPLING INSTALLATION

- A. Flexible Couplings and Flange Coupling Adaptors: Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolt on opposite sides a little at a time until all bolts have a uniform tightness. Workers tightening bolts shall be equipped with torque-limiting wrenches or other favorably reviewed type. Anchor studs on restrained flanged coupling adapters shall be installed so as to lock into holes drilled through pipe wall in accordance with manufacturer's recommendation.
- B. Flexible Expansion Joints: Install in accordance with manufacturer's instructions, unless otherwise shown, install flat, with half the maximum expansion.

3.06 PIPE SUPPORT INSTALLATION

- A. General:
 - 1. Install and adjust supports for each pipeline such that the pipeline is true to the indicated line and grade.
 - 2. Locate anchors and braces for any single support on a continuous structure; that is, not on two sides of a structural expansion joint.
 - 3. Tighten clamps to develop full friction along the pipeline except where loose fitting clamps are called for.
- B. Electrolytic Protection: Pipe supports serving copper pipe or tubing shall be dielectrically insulated from the pipe by dielectric sleeves or plastic pipe wrap at the point of contact

3.07 INSTALLATION OF VALVES AND ACCESSORIES

- A. Wrap buried valve bodies as specified for flexible couplings and flanged coupling adapters.

3.08 CLEANING

- A. Prior to testing, thoroughly clean the inside of each completed piping system of all dirt, loose scale, sand and other foreign material. Cleaning shall be by sweeping, flushing with water or blowing with compressed air or oil-free nitrogen gas, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment or take other appropriate measures to protect equipment while cleaning piping.
- B. Special attention and skill is required to properly clean piping, valves and accessories for chlorine solutions service. After erection, the chlorine solution piping shall be flushed with clear water until there is not evidence of dust, dirt or debris

3.09 FIELD TESTING

- A. General: Perform leakage tests on all pipe installed in this project. Furnish all equipment, material, personnel and supplies to perform the tests and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified and as shown in the following Schedule. Test pressure shall be measured at the highest point on the line, except that pressure at lowest point shall not exceed pipe manufacturer's rated test pressure, unless specifically noted otherwise. Leakage tests shall be performed on all piping at a time agreed upon and in the presence of the Engineer.
- B. Buried Piping: The leakage test for buried piping shall be made after all pipe is installed and backfilled. However, the Contractor may conduct preliminary tests prior to backfill. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.
- C. Exposed Piping: All supports, anchors and blocks shall be installed prior to the leakage test. No temporary supports or blocking shall be installed for final test.
- D. Encased Piping: The leakage test for encased piping shall be made after all pipe is installed and encased, and before any structures are constructed above it. However, the Contractor may conduct preliminary tests prior to encasement. If the Contractor elects to conduct preliminary tests, provide any necessary temporary thrust restraint.
- E. Accessories: It shall be the responsibility of the Contractor to block off or remove equipment, valves, gauges, etc., which are not designed to withstand the full test pressure.
- F. Testing Apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing including valves to isolate the new system, addition of test media, and draining lines and disposal of water, as is necessary. These openings shall be plugged in a manner favorably reviewed by the Engineer after use. Provide all required temporary bulkheads.
- G. Pneumatic Testing: Piping tested by air or another gas shall show no reduction of pressure during the test period after corrections have been made for changes in

temperature in conformance with the following relationship: $(P1/T1)=(P2/T2)$, Where T1 and T2 are the absolute temperatures of the gas in the pipe and P1 and P2 are the absolute pressures. The subscript "1" denotes the starting conditions and the subscript "2" denotes the final conditions.

- H. Precautions for Pneumatic Testing: Where air or another gas is called for as the test medium, the Contractor shall take special precautions to protect personnel. During the initial pressurization of a pipeline to the specified test pressure, personnel shall be protected by suitable barricades or shall remove themselves to locations where a concrete structure is between them and the pipeline under test.
- I. Correction of Defects: If leakage exceeds the allowable, the installation shall be repaired or replaced and leakage tests shall be repeated as necessary until conformance to the leakage test requirements specified herein have been fulfilled. All visible leaks shall be repaired even if the pipeline passes the allowable leakage test.
- J. Drying: Gas lines tested with water shall be drained and blown dry with air or oil-free nitrogen gas. The annular space of the double containment piping shall be purged of moisture containing air and replaced with clean dry nitrogen.
- K. Reports: The Contractor shall keep records of each piping test, including:
 - 1. Description and identification of piping tested.
 - 2. Test pressure.
 - 3. Date of test.
 - 4. Witnessing by Contractor and Engineer.
 - 5. Test evaluation.
 - 6. Remarks, to include such items as:
 - a. Leaks (type, location).
 - b. Repairs made on leaks.
- L. Test reports shall be submitted to the Engineer.
- M. Venting: Where not shown on the Drawings, the Contractor may install valved "tees" at high points on piping to permit venting of air. Valves shall be capped after testing is completed.
- N. No leakage shall be permitted for exposed piping.
- O. Testing Specifics: Piping shall be tested as indicated in the following Schedule. All other piping systems shall be tested as required for the pipe type used. Unless specified otherwise, test each system as noted below.

Piping Test Schedule					
Legend	Pipe	Test Pressure (psi)	Test Medium	Allowable Leakage	Test Duration (hours)
W	GS	150	Water	0	3
W	CU	150	Water	0	3
W	DI	150	Water	Note 1	3
W	PVC	100	Water	Note 1	3

Notes:

- 1. No visible leakage. For buried PVC or ductile iron gasketed bell and spigot joints, use the following formula:

$$L = \frac{N D P^{1/2}}{7400}$$

where

L = allowable leakage, gallons per hour

N = number of joints being tested

P = pressure, psi

D = nominal pipe diameter, inches

2. Soap external joints and visually inspect for leaks.
3. Test per ASTM F 2164 "Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Hydrostatic Pressure." Test Pass/Fail Criteria per paragraph 9.8.

END OF SECTION

SECTION 02450

GRAVITY SEWER PIPE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Sanitary sewer pipe and fittings installed outside of buildings and major structures. All PVC gravity sanitary sewer piping 4-inch and larger shall be as specified herein.
- B. Related Sections:
 - 1. Section 02300: Earthwork

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM D2665 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - 2. ASTM D2855 – Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
 - 3. ASTM D3034 -- Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
 - 4. ASTM F679 -- Standard Specification for Polyvinyl Chloride (PVC) Large- Diameter Plastic Gravity Sewer Pipe and Fittings.
- B. East Palo Alto Sanitary District Standard Specifications

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300.
- B. Submittals shall include the pipe and fitting manufacturer's standard literature, details of joints, gasket material, and pipe length.
- C. Qualifications of and approval of sanitary sewer television firm by City Representative.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. All items shall be bundled or packaged in such a manner as to provide adequate protection of the ends during transportation to the site. Any pipe damaged in shipment shall be replaced at no additional cost to the City.

- B. PVC items deteriorate in sunlight and are slightly brittle, especially at lower temperatures, so care shall be taken in loading, transporting, and unloading items to prevent injury to the items. All items shall be examined before installation and no piece shall be installed which is found to be defective. Handling and installation of pipe and fittings shall be in accordance with the manufacturer's instructions, referenced standards and as specified herein.
- C. Any pipe or fittings showing a crack or which has received a blow that may have caused an incident fracture, even though no such fracture can be seen, shall be marked as rejected and removed at once from the work.
- D. While stored, pipe shall be adequately supported from below at not more than 3-ft intervals to prevent deformation. Manufacturer requirements that are more restrictive than those herein shall be followed. The pipe shall be stored in stacks no higher than that given in the following table:

<u>Pipe Diameter (inches)</u>	<u>Max. No. of Rows Stacked</u>
8 or less	5
12	4
18	3

- E. Pipe and fittings shall be stored in a manner which will keep them at ambient outdoor temperatures and out of the sunlight or delivered to the site so that no pipe is exposed to sunlight for more than 60 days. Temporary shading as required to meet this requirement shall be provided. Simple covering of the pipe and fittings which allows temperature buildup or direct or indirect sunlight will not be permitted.
- F. If any defective item is discovered after it has been installed, it shall be removed and replaced with an exact replacement item in a satisfactory manner by the Contractor, at no additional cost to the City. All pipe and fittings shall be checked and thoroughly cleaned before installation and the interior shall be kept clean until testing.
- G. In handling PVC items, use special devices and methods as required to achieve the results specified herein. No uncushioned devices shall be used in handling the item

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- A. Sanitary sewer gravity pipe and fittings shall be PVC solid wall SDR 26 with full diameter dimensions conforming to ASTM D3034 for sizes 4-inch to 15-inch, and ASTM F679 for sizes 18-inch to 27-inch. Pipe and fittings by J-M, PW Eagle, or approved equal.

2.02 JOINTS

- A. Joints in gravity piping shall be stab type, with elastomeric gaskets. Gaskets shall be synthetic rubber; natural rubber is not acceptable. Joints in pressure piping shall be solvent weld.

2.03 CLEANOUT BOXES

- A. For vertical cleanout piping cleanout boxes shall be circular concrete with cast iron traffic lids, designed for HS20 traffic loads, and sized to allow the extension of the cleanout pipe into the throat of the box. Pressure pipe and sloped gravity cleanout boxes shall be rectangular concrete with galvanized steel traffic lids, designed for H20 traffic loads, and sized to allow the extension of the cleanout pipe flange or coupling/plug into the box with interior box space for access and use. Cleanout boxes shall be by Christy Concrete Products, Brooks, Central Precast Concrete, Hanson Pipe and Products, or approved equal

PART 3 – EXECUTION

3.01 GENERAL

- A. Pipe, fittings, and appurtenances shall be handled in a manner that will ensure installation in a sound, undamaged condition. Gravity pipe storage, handling, and installation shall be in accordance with the manufacturer's written instructions unless specifically modified by the Specifications or Drawings. Pressure pipe shall be assembled in accordance with ASTM D2855 and stored, handled, and installed in accordance with the manufacturer's written instructions.
- B. Pipe and fittings shall be carefully examined for cracks, damaged linings, and other defects immediately prior to installation. Spigot and bell ends shall be particularly examined and cleaned with care. All defective pipe and fittings shall be clearly marked as such and removed from the site of the work.
- C. Cleanout piping shall branch from the main pipe run using wye or 45 degree ell fittings. Where space permits on piping the cleanout pipe extension shall extend to the surface at 45 degrees to the horizontal. If space does not permit, cleanout piping shall be turned vertical with the appropriate fittings.
- D. All piping installation shall be in accordance with East Palo Alto Sanitary District Standard Specifications, dated 6 June 2002. Where these standard specifications

conflict with the specifications presented herein, the more stringent of the two shall govern.

3.02 LAYING PIPE

- A. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified in Section 02300. Under no circumstances shall pipe be laid in water and no pipe shall be laid under unsuitable weather or trench conditions. During cold weather, particular care shall be taken in handling and laying pipe to prevent impact damage. Pipe shall be laid with bell ends facing the direction of laying except when reverse laying is specifically permitted by the City Representative. Foreign matter shall be prevented from entering the pipe during installation.
- B. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug. All water in the trench shall be removed prior to removing the plug.
- C. Pipe shall be kept shaded and as cool as possible during installation and shall be covered with backfill immediately after installation.
- D. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted.
- E. Alignment:
 - 1. Piping shall be laid to the lines and grade indicated on the Drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the maximum deflections specified by the manufacturer.
 - 2. Unless otherwise specified or indicated on the Drawings, and subject to the acceptance of the City Representative, either shorter pipe sections or fittings shall be installed as required to maintain the indicated alignment or grade.
 - 3. PVC pipe shall not be deflected at any joints. Curvature of the pipe shall not exceed the manufacturer's recommendations.
- F. Cuts shall be smooth, straight, and at right angles to the pipe axis. After cutting, the end of the pipe shall be dressed to remove all roughness and sharp corners and beveled in accordance with the manufacturer's instructions.

3.03 JOINTING

- A. Jointing operations shall conform to the instructions and recommendations of the pipe manufacturer. All joint surfaces for gasketed joints shall be lubricated immediately before the joint is completed. Gaskets and lubricants shall be as supplied by pipe manufacturer, shall be suitable for use in potable water, shall be compatible with the pipe materials, shall be stored in closed containers, and shall be kept clean. Each spigot shall be suitably beveled to facilitate assembly.

3.04 CONNECTIONS WITH EXISTING PIPING

- A. Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe, fitting, or manhole shall be made at a time and under conditions which will least interfere with service, and as authorized by the Owner.

3.05 HYDROSTATIC LEAKAGE TESTS

- A. Hydrostatic exfiltration leakage tests shall be completed for all drain piping runs which are longer than 20 feet between inlets, manholes, sumps, or similar facilities. Test pressure shall be 20 feet of water head. Tests shall be completed after backfilling but prior to the placement of permanent paving or fine grading. All pipe openings shall be plugged with pneumatic bags or mechanical plugs in such a manner that the entrapped air can be released from the pipe while it is being filled with water. Equipment shall be provided to adequately pressurize the pipeline and accurately measure water leakage to the nearest 0.05 gallon. Each test period shall be 2 hours.
- B. For the 2 hour hydrostatic leak test to be successful, the actual leakage must be less than that calculated by the following equation:

$Q = DL (0.0008)$, where: Q is the maximum allowable leakage in gallons; D is the diameter of the pipe in inches; L is the length of the pipe run in feet.

The Contractor shall make all repairs as required until the pipeline successfully passes this test at no additional cost to the City.

END OF SECTION

SECTION 02520

WATER SUPPLY WELLS

PART 1 - GENERAL

1.01 GENERAL

A. SUMMARY OF WORK:

The following sections describe requirements for the well construction portion of the City of East Palo Alto Standby Well project, located at the intersection of Clarke Avenue and Bayshore Avenue, a commercial/residential district in East Palo Alto, California. This portion of the project includes installation of conductor casing with outer annular seal, drilling a pilot borehole, alignment survey of the pilot borehole, reaming the borehole, assembly and installation of well casing and screen and appurtenances, emplacement of annular materials, well development, well performance testing, well disinfection, and well video logging. Details of the project are listed below.

B. MITIGATION MEASURES FROM ENVIRONMENTAL IMPACT REPORT (EIR):

For mitigation measures, see Section 01140 Environmental Protection.

C. BID ITEM

Per the Bid Schedule in Division 0, there will be one (1) bid item for well construction. Contractor shall submit Schedule of Values for this one (1) bid item which at a minimum shall include the items listed at the end of this specification, and shall submit using the unit values described for each item in the Payment paragraph of this specification.

1.02 REFERENCES

- A. American Water Works Association (AWWA) Standard No. A100-06
- B. American Petroleum Institute (API) Recommended Practice (RP) 13B
- C. American Society for Testing and Materials (ASTM) C150
- D. ASTM A409 and A778
- E. ASTM No. A606 Type 4
- F. Department of Water Resources (DWR) Bulletin Nos. 74-81 and 74-90
- G. American Welding Society (AWS) standards
- H. National Science Foundation (NSF 61)
- I. San Mateo County Ordinance Code Chapter 4.68 – Wells
- J. State Water Resources Control Board Well Construction Requirements and Recommendations

1.03 SUBMITTALS

A. PRODUCT REVIEW SUBMITTALS:

- 1. DRILLING FLUID CONTROL PROGRAM:

- The Contractor shall be responsible for designing and controlling a drilling program that conforms to sampling requirements specified in Section 3.02 SAMPLING.
2. **SEALING MATERIAL:**
The Contractor shall submit to the Owner or Engineer for approval a description of the sealing material to be used, detailing its source, composition and preparation.
 3. **CONDUCTOR CASING:**
The Contractor shall submit three (3) copies of the conductor casing mill certificate to the Owner or Engineer for approval before delivering the conductor casing to the job site.
 4. **PRIMARY WELL CASING:**
The Contractor shall submit three (3) copies of the mill certificate to the Owner or Engineer for approval before delivering casing to the job site.
 5. **WELL SCREEN:**
The Contractor shall submit screen specifications including the name of the proposed screen manufacturer, well screen dimensions, rod dimensions, wire dimensions, slot size, weld type, material, and strength specifications such as collapse strength, tensile strength, and supporting drawings. The Contractor shall submit three (3) copies of the mill certificate to the Owner or Engineer for approval before delivering well screen materials to the job site.
 6. **FILTER PACK MATERIAL:**
The acceptability of artificial filter pack material shall be determined based upon certified laboratory test results and service records for the source of the material. Prior to delivery to the project site, the Contractor shall submit the following to Owner and Engineer for approval:
 - a. Source of filter pack material.
 - b. Certified results from laboratory tests performed in accordance with ASTM C136 demonstrating that the filter pack material meets the material and gradation criteria specified herein.
 - c. A one (1) kilogram sample of the material allowing the Owner, at Owner's discretion and expense, to conduct tests to independently determine the properties of the filter pack material.
 7. **TRANSITION SAND MATERIAL:**
The Contractor shall submit to the Owner or Engineer for approval a description of the transition sand material to be used, detailing its source, gradation, and composition.
 8. **FILTER PACK FEED PIPE:**
The Contractor shall submit one (1) copy of the mill certificate to the Owner or Engineer for approval before delivering the filter pack feed pipe to the job site.
 9. **WELL DEVELOPMENT TOOL SHOP DRAWING:**
The Contractor shall submit to the Owner or Engineer for approval a shop drawing of the tool(s) proposed for use during well development by air lift and swabbing.
 10. **DISCHARGE MEASUREMENT DEVICE OR METHOD:**
The Contractor shall provide proof or demonstration of the accuracy of their flow measurements upon request from the Owner or Engineer.
 11. **WELDING PLAN:**
The Contractor shall submit to Owner or Engineer for approval a welding plan, detailing the methods and materials to be used during assembly of all welded components of the well.

1.04 QUALITY ASSURANCE

A. PILOT BOREHOLE PLUMBNESS TOLERANCE:

The tolerance for pilot borehole plumbness shall be based on the AWWA Standard No. A100-06 and the dimensions of the supply well to be constructed. The maximum allowable drift (per 100 feet of depth) of the pilot borehole from the vertical shall not exceed two-thirds (2/3) of the smallest inside diameter of the supply well casing (see Section 2.04 PRIMARY WELL CASING) or supply well screen (see Section 2.05 WELL SCREEN) to be installed in the portion of the pilot borehole being tested. This tolerance amounts to 8.92 inches per 100 feet of depth. The plumbness tolerance shall apply to that portion of the borehole between the ground surface and the depth of the top of the uppermost screened interval, as shown on **Error! Reference source not found.** Drawing W-1.

B. PLUMBNESS TOLERANCE:

Tolerances for plumbness for the portion of the supply well extending from the ground surface to the maximum depth of the pump chamber (240 ft bgs) shall be based on the AWWA Standard No. A100-06, as follows:

Plumbness shall be determined at depth intervals of 10 feet or more frequently when approaching the allowable maximum. The test for plumbness shall be determined by calculating the drift at each interval. The drift is calculated as the product of the deflection and the distance from the plunger to the apex, divided by the depth of the plunger below the top of the hole. The deflection is the measured horizontal deflection of the plumb line from center of the top of the casing. The maximum allowable drift of the supply well from the vertical shall not exceed two-thirds (2/3) of the smallest inside diameter of that part of the supply well being tested per 100 feet of depth.

C. ALIGNMENT TOLERANCE:

Tolerances for alignment for the portion of the supply well extending from the ground surface to the maximum depth of the pump chamber (240 ft bgs) shall be based on the AWWA Standard No. A100-06, as follows:

The alignment must be satisfactory for the successful operation of both temporary and permanent pumping equipment, including a line-shaft turbine groundwater pump. The test for alignment shall be satisfactory upon demonstrating that the specified section of pipe or dummy moves freely throughout the tested interval.

D. SEALING MATERIAL INSTALLATION VERIFICATION:

The Contractor shall verify the proper placement of sealing material by demonstrating that the volume of sealing material placed in the annular space equals or exceeds the annulus volume.

E. WELL PERFORMANCE TESTING PUMPING RATE TOLERANCE:

An accurate device or method for measuring the discharge rate of the pump shall be provided, installed, and maintained by the Contractor. The device shall be capable of measuring the flow within an accuracy of five percent (5%) throughout the 150 to 750 gpm range. The Contractor shall provide proof or demonstration of the accuracy of their flow measurements upon request from the Owner or Engineer. The method of measuring discharge rate shall be approved by the Owner or Engineer prior to Contractor developing the well.

1.05 SCHEDULING

A. NOTICE TO OWNER AND ENGINEER PRIOR TO OUTER ANNULAR SEAL INSTALLATION:

The Contractor shall notify the Owner and Engineer a minimum of 24 hours in advance of planned sealing material placement.

B. NOTICE TO OWNER AND ENGINEER PRIOR TO PILOT BOREHOLE GEOPHYSICAL TESTING:

The Contractor shall provide the Owner and Engineer with 24-hour notice of the time for completing drilling of the pilot borehole to total depth as determined in the field to enable the Owner or Engineer to schedule the geophysical testing service.

C. NOTICE TO OWNER AND ENGINEER PRIOR TO INNER ANNULAR SEAL INSTALLATION:

The Contractor shall notify the Owner and Engineer a minimum of 24 hours in advance of planned sealing material placement.

D. WELL SEAL CURING PERIOD:

Upon installation of the sealing material and unless approved otherwise by the Owner or Engineer, no further work shall be completed on the supply well until the seal has been allowed to cure for a minimum of 48 hours after emplacement. The 48-hour curing period shall not be regarded as standby time as defined in Section 1.05 SCHEDULING.

E. STANDBY TIME ORDERED BY OWNER:

1. Standby time shall be paid only for inactive periods approved by Owner. Idle time required for maintenance or failure of equipment shall not be measured as standby time. Idle time as a result of weather delays shall not be measured as standby time. Standby time shall be based on one work shift per day (8 hours) regardless of the Contractor's operating schedule. Standby time will not be paid for Saturdays, Sundays, or holidays on which work is not customarily performed, unless the Contractor has previously agreed to work on such days.
2. Payment: Payment for standby time shall be made at the unit price per hour as shown on the bid schedule, and only for that part of a regular eight-hour shift during which the Contractor may not continue work because of the requirements of the specifications (Bid Item 28).

1.06 SELECTION PERIODS

A. SCREEN LENGTH AND APERTURE SELECTION PERIOD:

Owner and Engineer shall require a selection period to confirm the screen length and to determine the screen aperture using data from the well borehole.

1. The final selection of screen aperture size will be provided by the Owner or Engineer at the end of the selection period based on formation samples collected and analyzed for grain size distribution, as described in Section 1.08 RECORDS and 3.02 SAMPLING.
2. The final length and depth of individual sections of stainless steel well screen will be provided by the Owner or Engineer at the end of the selection period based on data gathered during the pilot borehole drilling and geophysical logging process. For purposes of bid formulation, the Contractor shall assume the overall length of the well screen to be 115 feet. Unless approved otherwise by the Owner or Engineer, the Contractor shall use screen sections of a minimum length of twenty (20) feet, wherever possible.

3. The selection period shall begin at 9:00 AM on the first business day after all of the following have occurred: (1) pilot borehole drilling is complete, (2) geophysical logging is complete, (3) formation samples have been accepted by Owner or Engineer, and (4) all preparation work required prior to borehole reaming is complete. The selection period shall end when the Contractor is notified by the Owner or Engineer of the selected aperture size and length of the screen. Notification for the purpose of ending this selection period shall be conducted verbally either in person or by telephone, and shall be confirmed in writing the same date as verbal notification is completed. Contractor may not charge standby time, as defined in Section 1.05 SCHEDULING, for the first 48 hours of the selection period.

B. FILTER PACK SELECTION PERIOD:

Owner and Engineer shall require a selection period to designate the filter pack gradation. The selection period coincides with the selection period for Screen Length and Aperture Selection Period and the same conditions apply. The final selection of filter pack material shall be made during the filter pack gradation selection period.

1.07 DISPOSAL OF FLUIDS AND CUTTINGS

A. GENERAL:

The Contractor shall be responsible for properly disposing of all drilling fluids and cuttings resulting from all drilling operations and all water resulting from well development, performance testing (pumping), and well disinfection operations. All permits needed for water discharge to any facility shall be acquired by the Contractor from the appropriate authority (See Article 7 of Section 00700 for permit requirements). Costs of fluids, cuttings, and well disinfection water disposal shall be borne by the Contractor and payment shall be made based on the amount of such materials disposed and the unit prices stated on the Bid Form.

B. DISPOSAL OF DRILLING FLUIDS AND CUTTINGS:

Unless approved otherwise by the Owner, all drilling fluids and cuttings must be contained onsite in above-ground storage containers for subsequent off-site disposal at a facility authorized to accept such material. The Owner or Engineer will designate a location on-site for the temporary containment of drilling mud and cuttings. No sub-grade mud pits may be used. The Contractor is responsible for arranging and paying for costs for off-site disposal of the drilling fluids and cuttings.

C. DISCHARGE OF WELL DEVELOPMENT WATER:

Unless approved otherwise by the Owner, all discharge water resulting from well development shall first be directed into a settling tank for solids separation. The decanted liquids shall be disposed of either offsite, or to the storm sewer, as directed by the Owner. The solids shall be disposed of off-site by Contractor at a facility authorized to accept such material. The Contractor is responsible for arranging and paying for costs for off-site disposal of the settled solids resulting from well development.

D. DISCHARGE OF WELL PERFORMANCE TESTING WATER:

All discharge water resulting from well performance testing shall be disposed either offsite or to the storm sewer, as directed by the Owner.

E. DISCHARGE OF WELL DISINFECTION WATER:

Unless approved otherwise by the Owner, all discharge water resulting from well disinfection shall be contained onsite in above-ground storage containers for

subsequent off-site disposal at a facility authorized to accept such material. The Contractor is responsible for arranging and paying for costs for off-site disposal of the well disinfection water.

F. PAYMENT:

1. Payment for disposal of drilling fluids and cuttings, settled solids resulting from well development, and well disinfection water shall include full compensation for furnishing all labor, materials, tools and equipment, and the performance of all work in accordance with these specifications.
2. Payment for disposal of drilling fluids and cuttings, settled solids resulting from well development shall be made based on the volume of solid materials and drilling fluids (in cubic yards) disposed at the unit price indicated on the Bid Sheet (Bid Item 2).
3. Payment for disposal of well disinfection water shall be made based on the volume of disinfection water (per gallon) at the unit price indicated on the Bid Sheet (Bid Item 3). See Article 15 of Section 00700 for Payment terms.

1.08 RECORDS

A. DAILY REPORT:

1. The Contractor shall maintain and deliver upon request to the Owner or Engineer a detailed daily report ("Daily Report") describing site activities. The Daily Report shall include the following information:
 - a. Description of all formations encountered
 - b. Number of feet drilled
 - c. Number of hours of active drilling and number of hours on the job
 - d. Duration and cause of any shutdowns, whether or not the shutdown is under Contractor's control or other occurrence (see Section 1.05 SCHEDULING **Error! Reference source not found.**)
 - e. Number of feet of casing and/or screen installed
 - f. Number and type of samples collected, including sample depths
 - g. Other pertinent data, as requested by the Owner or Engineer.
2. The Contractor shall measure and record the fluid level in the hole daily prior to starting pumps and drilling.

B. WELL COMPLETION REPORT:

Upon completion of the Work and in accordance with the California Water Code, the Contractor shall prepare a Well Completion Report for the Pad D Standby Well and file the report with the DWR and the appropriate authorities within San Mateo County. The Contractor shall provide copies of the Well Completion Report to the Owner and Engineer. The Well Completion Report shall include as attachments copies of all logs from geophysical testing conducted in the borehole under Section 3.07 PILOT BOREHOLE GEOPHYSICAL TESTING.

C. DRILLER'S LOG:

1. In addition to the reporting requirements for the Well Completion Report, the Contractor shall maintain a complete log, as applicable, setting forth the following items:
 - a. The reference point for all depth measurements
 - b. The depth at which each change of formation occurs
 - c. The depth and thickness of each aquifer
 - d. The type of aquifers encountered
 - e. The depth interval from which each formation sample was taken

- f. The depth of any borehole diameter changes
 - g. The total depth of borehole and completed supply well
 - h. The depths of lost circulation zones
 - i. The depth of all intervals
 - j. The nominal hole diameter of the well bore above and below the casing seal
 - k. The type and quantity of sealing material installed
 - l. The depth and description of the well casing
 - m. Data regarding well screen type, size, and depth installed in the well bore
 - n. Any and all other pertinent information required by these specifications.
2. The Contractor shall provide the Driller's Log to Engineer upon request.
- D. PENETRATION RATE LOG:
The Contractor shall maintain a Penetration Rate Log showing the time that each drill rod connection is used for and the length of the rod. The Penetration Rate Log shall also note the types and weights of bits and drill collar(s) used in the various sections of the hole.
- E. STRATIGRAPHIC LOG:
The Engineer shall prepare a Stratigraphic Log to accompany the set of formation samples (see Section 3.02 SAMPLING), noting the depth, thickness, and characteristics of encountered strata (including size, range, and shape of particles, smoothness, and rock type), rate of penetration, and other pertinent information. The Contractor shall cooperate and provide assistance to the Engineer in collecting data for preparation of the Stratigraphic Log.
- F. BOREHOLE ABANDONMENT LOG:
If the borehole is abandoned per direction from the Owner and Engineer, per Section 3.06 PILOT BOREHOLE PLUMBNESS TESTING, the Contractor shall submit to the Owner and Engineer complete records of the entire abandonment procedure to provide a record that the hole was properly sealed as specified in Section 3.08 PILOT BOREHOLE ABANDONMENT.
- G. WELL PLUMBNESS AND ALIGNMENT TESTING LOG:
Upon completion of the well plumbness and alignment testing, the Contractor shall provide to Owner and Engineer all records of the well plumbness and alignment testing.
- H. BOREHOLE GEOMETRY AND DEVIATION SURVEY LOG:
If Contractor conducts a borehole geometry and deviation survey per Section 3.14 WELL PLUMBNESS AND ALIGNMENT TESTING, the Contractor shall provide to Owner and Engineer all records of such survey.
- I. WELL ABANDONMENT LOG:
If the well is abandoned per direction from the Owner and Engineer, per Section 3.15 WELL ABANDONMENT, the Contractor shall provide to the Owner and Engineer complete records of the entire abandonment procedure to provide a record that the well was properly destroyed. The records shall include the type and quantity of sealing material, the depth at which the sealing materials were placed. Records shall include documentation of approval of well destruction by the permitting agency.
- J. WELL DEVELOPMENT RECORDS:
Complete records of all development work shall be maintained by the Contractor and provided to the Owner and Engineer upon request. The records shall include the following items and the date and time of measurement:

1. Quantity of filter pack material added during development.
 2. Quantity and description of any material placed into the supply well.
 3. Static and pumping water levels.
 4. Methods of measurement.
 5. Duration of each operation.
 6. Production rates and specific capacity.
 7. Sand content as a function of production rate and time.
 8. Sand content as a function of production rate and specific capacity.
 9. All other pertinent information.
- K. WELL PERFORMANCE TESTING RECORDS:
1. During the Variable Rate Pumping Test, the Contractor shall be responsible for recording the discharge and pumping levels of the supply well.
 2. During the Constant Rate Pumping Test, the Contractor shall be responsible for recording all discharge and water level measurements during drawdown and recovery.
- L. PAYMENT:
- No separate or additional payment shall be provided for the records requirements specified herein. Payment therefore shall be included in the various bid items of work. See Article 15 of Section 00700 for Payment terms.

PART 2 - PRODUCTS

2.01 DRILLING FLUIDS

A. GENERAL:

All drilling fluids shall be acceptable for water well drilling in accordance with AWWA Standard No. A100-06, and shall be approved by the Engineer prior to use. Any drilling fluids proposed for use shall be noted on the bid sheet questionnaire. No additives shall be added to the drilling fluid unless the Contractor obtains prior written approval from the Owner or Engineer. All drilling fluids shall be especially compounded for water well construction, designed for minimum aquifer penetration, and shall not damage the potential capacity, efficiency, or quality of the supply well. Should a conflict arise between drilling fluid requirements for ease in drilling and requirements for aquifer protection, then the ruling requirements shall be those for aquifer protection.

B. DRILLING FLUID PROPERTIES:

Unless approved otherwise by the Engineer, drilling fluid properties shall be maintained within the following limits using test procedures conforming to American Petroleum Institute ("API") R.P.-13-B "Procedures for Testing Drilling Fluids" ("API RP 13B"):

1. Direct Mud Rotary Drilling Fluid Properties:
 - a. Weight (fluid density): 70-85 pounds per cubic foot (9.4 - 11.4 pounds per gallon).
 - b. Marsh Funnel Viscosity: 32-40 seconds per quart.
 - c. Filtration (wall cake and filtration loss): maximum thickness of 3/32 inches with maximum 30-minute water loss of 20 cubic centimeters (cc).
 - d. Sand contents (solids larger than 200 mesh): maximum of two (2) percent by volume.
2. Reverse Mud Rotary Drilling Fluid Properties:
 - a. Weight (fluid density): 64-68 pounds per cubic feet.

- b. Marsh Funnel Viscosity: 28-34 seconds per quart.
- c. Filtration (wall cake and filtration loss): maximum thickness of 3/32 inches with maximum 30-minute water loss of 20 cubic centimeters (cc).
- d. Sand contents (solids larger than 200 mesh): maximum of two (2) percent by volume.

C. PAYMENT:

No separate or additional payment shall be provided for the drilling fluid requirements specified herein. Payment therefore shall be included in the various bid items of work. See Article 15 of Section 00700 for Payment terms.

2.02 SEALING MATERIALS

A. GENERAL:

Sealing material shall consist of neat cement or sand cement grout. Used driller's mud or cuttings from drilling shall not be used as sealing material. Water used to prepare sealing mixtures generally shall be of drinking water quality and shall be free of petroleum products, suspended material, and other deleterious substances. With the exception of the transition seal described in Section 2.09 TRANSITION SAND MATERIAL, accelerators, retardants, bentonite, and other additives shall not be used without prior approval by the Owner or Engineer. All sealing materials will be certified for use in drinking water wells in accordance with National Sanitation Foundation ("NSF") standard NSF 61. If approved, bentonite may be added up to six (6) percent by weight.

B. NEAT CEMENT:

Neat cement shall consist of ASTM C150 Type I or II Portland cement at a ratio of five (5) to six (6) gallons of water per 94-pound sack of cement.

C. SAND-CEMENT GROUT:

Sand-cement grout shall consist of a mixture of ASTM C150 Type II Portland cement, sand, and water in the proportion of not more than two (2) parts, by weight, of sand to one (1) part of cement with not more than seven (7) gallons of water per 94-pound sack of cement, or other ratios as required by the drilling permit.

D. PAYMENT

Payment for outer sealing material (Bid Item 8) shall be based on cubic yards of material installed in the seal. Payment for inner sealing material (Bid Item 18) shall be based on cubic yards of material installed in the seal. See Article 15 of Section 00700 for Payment terms.

2.03 CONDUCTOR CASING

A. GENERAL:

A permanent conductor casing shall be installed to a depth shown on Drawing W-1 to prevent shallow unstable hole conditions and to isolate the pilot borehole from shallow groundwater during the drilling and reaming of the pilot borehole and construction of the supply well.

B. MATERIAL:

The conductor casing shall be high-strength low-alloy ("HSLA") steel meeting ASTM Standard No. A606 Type 4. All conductor casing materials will be certified for use in drinking water wells in accordance with NSF 61.

C. DIAMETER:

The conductor casing shall be 24 inches outside diameter, and 23-3/8 inches inner diameter.

D. THICKNESS:

The conductor casing shall be 5/16-inches in thickness.

E. PAYMENT:

Payment for the conductor casing and materials related to the conductor casing shall be in vertical feet installed to the total depth directed (Bid Item 6). See Article 15 of Section 00700 for Payment terms.

2.04 PRIMARY WELL CASING

A. MATERIAL:

All well casing material shall be new Type 304 stainless steel conforming to ASTM A409 and A778. All well casing materials will be certified for use in drinking water wells in accordance with NSF 61.

B. DIAMETER:

All well casing shall be round in cross-section and have a nominal diameter of 14 inches, an outside diameter of 14 inches, and an inside diameter of 13-3/8 inches.

C. THICKNESS:

The well casing wall thickness shall be 5/16 inches.

D. LENGTH:

The well casing shall include a riser pipe extending from the top of screen depth to three (3) feet above ground surface and a tailpipe extending from the bottom of screen depth to the total supply well depth. Dimensions are shown on Drawing W-1. The final total length and the length and depth of individual sections of stainless steel well casing will be determined by Owner and Engineer based on data gathered during the pilot borehole drilling and geophysical logging process. Unless approved otherwise by the Owner or Engineer and except for end pieces and casing to be connected to well screen sections, all sections of well casing shall be a minimum length of twenty (20) feet

E. PAYMENT:

Payment for furnishing of well casing materials shall be in vertical feet determined as the length set below ground surface plus the finished casing height above ground surface. Payment for well casing material shall be on a unit price per foot of length of well casing including the cost of shipping (Bid Item 12). See Article 15 of Section 00700 for Payment terms.

2.05 WELL SCREEN

A. CONSTRUCTION:

The well screen shall be of the continuous slot, wire-wrapped design. The well screen shall be fabricated by circumferential wrapping of a triangularly shaped wire around a circular array of rods. The wire configuration must produce inlet slots with sharp outer edges, widening inwardly to minimize clogging. For maximum collapse strength, each juncture between the horizontal wire and the vertical rods shall be fusion welded under water by the electrical resistance method. The well screen shall be manufactured by Johnson Division, Roscoe Moss, or equivalent manufacturer approved by the Owner or Engineer.

B. MATERIAL:

All well screen shall be new and fabricated from Type 304 stainless steel conforming to ASTM A409. All well screen materials will be certified for use in drinking water wells in accordance with NSF 61. Screens shall be manufactured in various lengths complete with stainless steel welding collars attached to each end.

C. END FITTINGS:

End fittings shall be new and fabricated from Type 304 stainless steel conforming to ASTM A409.

D. DIAMETER:

The well screen shall have a nominal diameter of 14 inches, an actual outside diameter of 14 inches, and an inner passing diameter (i.e., inside of rods) of 13-3/8 inches.

E. STRENGTH:

The well screen shall have sufficient strength to withstand anticipated tensile, formation, hydrostatic, and dynamic pressures imposed on the screen during installation, well development, and use. The minimum screen tensile strength must exceed at least twice the total weight of the screen and any standard wall blank casing suspended below the top screen joint.

F. PAYMENT:

Payment for furnishing of well screen materials shall be in vertical feet as determined as the summation of the screen intervals over the distance from the top of the tailpipe to the bottom of the riser pipe. Payment for furnishing of well screen materials shall be on a unit basis per foot of length of well screen length including the cost of shipping (Bid Item 14). See Article 15 of Section 00700 for Payment terms.

2.06 CENTRALIZERS

A. GENERAL:

Centralizers shall be new and fabricated from Type 304 stainless steel conforming to ASTM A409.

B. THICKNESS:

Unless otherwise approved by the Owner or Engineer, each centralizer shall be two (2) inches in width, and 3/8 inch in thickness.

2.07 FILTER PACK

A. GENERAL:

All filter pack material shall be washed and free of shale, carbonate, mica, clay, dirt, loam, organic impurities, and other deleterious material of any kind. The material shall contain no iron or manganese in a form or quantity that will adversely affect the water supply from the supply well. The filter pack material shall be obtained from an approved source and shall consist of washed, graded, well-rounded silica particles with an average specific gravity of not less than 2.5. Not more than one (1) percent by weight of the material shall have a specific gravity of 2.25 or less. The material shall not contain more than two (2) percent by weight of thin, flat or elongated pieces (in which the largest dimension exceeds the smallest dimension multiplied by three). Not more than one (1) percent of the material shall be soluble in hydrochloric acid. The acceptability of artificial filter pack material shall be determined based upon certified laboratory test results and service records for the source of the material. Prior to delivery to the project site, the Contractor shall submit results and records as specified in Section 1.03 SUBMITTALS to Owner and Engineer.

B. GRADATION:

The filter pack material gradation shall be specified by Engineer upon completion of independent grain size analysis of selected formation samples collected during pilot borehole drilling, as described in Section 3.02 SAMPLING. The final selection of filter pack material shall be made during the filter pack gradation selection period (see Section 1.06 SELECTION PERIODS).

C. FILTER PACK DIMENSIONS:

3. Thickness:

The annular installed thickness of the filter pack adjacent to the well screen shall be four (4) inches, with a minimum thickness of three (3) inches and a maximum thickness of six (6) inches.

4. Length:

As shown on Drawing W-1, the final length of the filter pack shall extend from the bottom of the reamed borehole to a depth of 200 ft bgs, or as otherwise designated by Owner or Engineer.

D. PAYMENT:

Payment for furnishing of filter pack materials shall be in cubic yards of filter pack materials actually installed, to the nearest cubic yard, including the cost of shipping (Bid Item 16). See Article 15 of Section 00700 for Payment terms.

2.08 FILTER PACK FEED PIPE

A. GENERAL:

The filter pack feed pipe shall be composed of Grade A Standard (Schedule 40) Pipe with a nominal diameter and actual outer diameter of 3 inches.

2.09 TRANSITION SAND MATERIAL

A. GENERAL:

A five (5) foot transition seal comprised of hydrated bentonite or fine sand shall be emplaced above the filter pack and below the inner annular seal, as shown on Drawing W-1.

PART 3 - EXECUTION

3.01 MOBILIZATION AND DEMOBILIZATION

A. GENERAL:

Mobilization and demobilization include the assembly and transportation of all necessary tools, equipment, personnel, and materials to and from the project site to perform all of the Work required under these specifications. It also includes the site work and preparation necessary to accommodate the well drilling, development, testing, and final cleanup work on the grounds occupied by the Contractor required under these specifications.

B. PAYMENT:

The lump sum price paid for mobilization and demobilization to the project site shall cover all costs of transporting tools, equipment, personnel and materials to and from the drilling site, and all site preparation and cleanup work required (Bid Item 1). Fifty (50) percent of the total payment shall be paid on the first pay period after completion of the pilot borehole for the permanent conductor casing. The remaining fifty (50)

percent shall be paid upon final acceptance of the Work. See Article 15 of Section 00700 for Payment terms.

3.02 SAMPLING

A. FORMATION SAMPLING:

1. FREQUENCY OF SAMPLING:

During drilling of the conductor casing borehole and the pilot borehole, unless approved otherwise by the Owner, Contractor shall collect formation samples under the direction of the Engineer. Formation samples shall be collected every five (5) feet (or as directed by the Engineer) and at each change in formation. Unless otherwise directed by the Engineer, samples shall be collected in individual fabric soil sample bags or other containers approved by the Engineer with at least 1,000 gram capacity for each interval. Samples shall consist of at least 500 grams of drilled formation material, not including drilling fluid. Containers shall be plainly marked using indelible marker with the depth interval from which the sample was collected, the date and time of collection, and the well ID. The Contractor shall be responsible for the safe storage of formation samples until acceptance by the Owner or Engineer.

2. SAMPLING METHOD:

Unless approved otherwise by the Engineer, the formation sampling method shall be as follows. A return flow sample shall be collected by removing from the discharge fluid a representative sample of the formation by a means acceptable to the Engineer such as collecting the sample in a cuttings sample box, or catching it in a bucket and allowing the sample to settle out.

Particular care shall be used during collection of formation samples from the three depth intervals designated for grain size distribution analysis by Engineer, as shown on Drawing W-1. For these three sample intervals, the penetration of the bit shall stop when the top of the sampling interval is reached until all the cuttings from the last drilled section of the hole are evacuated from the borehole. The return ditch and sample catching device shall be cleaned of all cuttings before each sample is collected. The Contractor shall then drill to the bottom of the sampling interval and then circulate fluid until all the cuttings from the sampling interval are evacuated from the borehole, ensuring that representative cuttings from the sampling interval are being collected in the sampling device. The Contractor shall then carefully collect a cuttings sample from the sampling device.

B. WATER SAMPLING:

The Contractor shall coordinate with and provide necessary information to the Engineer in collecting any water samples during development and testing of the supply well.

C. DRILLING FLUID SAMPLING:

The Contractor shall collect and test samples of drilling fluids at the rig pump suction with sufficient care to ensure a true and representative sample. It is the Contractor's responsibility to provide and maintain all necessary equipment for measuring fluid properties. Unless approved otherwise by the Engineer, the drilling fluid tests shall be conducted: 1) every 50 feet of depth; or 2) every four (4) circulating hours, whichever is more frequent. The tests shall also be conducted whenever conditions appear to have changed, problems arise, or whenever requested by the Owner or Engineer.

The Contractor shall conduct all tests and shall maintain a log showing the drilling fluid properties set forth herein including date, time, depth, viscosity, drilling fluid weight, sand content, and any other tests requested by Engineer.

D. PAYMENT:

No separate or additional payment shall be provided for the sampling requirements specified herein. Payment therefore shall be included in the various bid items of work. See Article 15 of Section 00700 for Payment terms.

3.03 CONDUCTOR CASING INSTALLATION

A. GENERAL:

A permanent conductor casing shall be installed to a depth shown on Drawing W-1 to prevent shallow unstable hole conditions and to isolate the pilot borehole from shallow groundwater during the drilling and reaming of the pilot borehole and construction of the supply well. The conductor casing shall be installed in a borehole at least 30 inches in diameter, i.e., at least six (6) inches larger in diameter than the outer diameter of the conductor casing. Suitable steel guides or spacers similar to casing guides shall be provided in order to center and hold the conductor casing in its proper position until the outer annular seal has been emplaced.

B. DRILLING FLUID:

The requirements for drilling fluids set forth in Section 2.01 DRILLING FLUIDS shall apply to conductor casing installation, unless otherwise approved by Engineer.

C. PAYMENT:

Payment for drilling of the conductor casing borehole shall be in vertical feet drilled to the total depth directed (Bid Item 4). Payment for installation of the conductor casing shall be in vertical feet installed to the total depth directed (Bid Item 5). See Article 15 of Section 00700 for Payment terms.

3.04 OUTER ANNULAR (SANITARY) SEAL INSTALLATION

A. GENERAL:

Within the annular space between the conductor casing and the borehole wall, a minimum three (3) inch thick annular surface seal shall be emplaced to the depth of the conductor casing, as shown on Drawing W-1, by tremie pipe or other method approved by Engineer in accordance with requirements specified in DWR Bulletin Nos. 74-81 and 74-90 and any other local requirements. The outer annular seal shall be constructed of the materials set forth in Section 2.02 SEALING MATERIALS. Unless directed otherwise by the Owner or Engineer, all sealing material shall be installed in the presence of the Owner or Engineer. The Contractor shall notify all required authorities, including but not limited to the San Mateo County Environmental Health Department, in advance of the planned sealing material placement, as required by the well drilling permit and all applicable regulations.

B. PAYMENT:

Payment for emplacement of the sanitary seal outside of the conductor casing shall be on a per foot basis for installation and a volume basis for materials. Payment for installation of the sanitary seal shall include full compensation for furnishing all labor, tools, materials (excluding the outer annual seal material itself), and equipment and the performance of all work in accordance with these specifications (Bid Item 7). See Article 15 of Section 00700 for Payment terms.

3.05 PILOT BOREHOLE DRILLING

A. GENERAL:

The Contractor shall employ approved drilling methods and equipment and properly install the materials described herein so that the finished supply well: 1) conforms to the design illustrated in Drawing W-1, and 2) conforms to these specifications. The Contractor shall manage and dispose of drilling fluids and cuttings from pilot borehole drilling in accordance with the requirements set forth in Section 1.07 DISPOSAL OF FLUIDS AND CUTTINGS.

B. METHODS:

After the conductor casing has been installed, the Contractor shall allow the outer annular seal to cure for the greater of 48 hours or another duration as directed by Owner or Engineer. Following the curing period, the Contractor shall drill a 6-1/2-inch diameter borehole from the bottom of the conductor casing borehole to the total depth shown on Drawing W-1, as directed by the Owner or Engineer, using the direct mud rotary drilling method.

C. DRILLING FLUID:

The requirements for drilling fluids set forth in Section 2.01 DRILLING FLUIDS shall apply to pilot borehole drilling. The Contractor shall collect and test samples of drilling fluids using the methods and frequency described in Section 3.02 SAMPLING. Drilling fluid data shall be provided to the Owner and Engineer.

D. PAYMENT:

Payment for pilot borehole drilling shall be in vertical feet drilled below ground surface to the total depth directed in conformance with the plumbness standard set forth herein and minus any depth interval that is inaccessible for borehole geophysical testing (Bid Item 9). Payment shall include full compensation for furnishing all labor, materials, tools and equipment, and the performance of all work in accordance with these specifications. See Article 15 of Section 00700 for Payment terms.

3.06 PILOT BOREHOLE PLUMBNESS TESTING

A. GENERAL:

Upon completion of drilling of the pilot borehole, the Owner shall conduct borehole geophysical testing (see Section 3.07 PILOT BOREHOLE GEOPHYSICAL TESTING), including collection of a borehole geometry and deviation survey. The Owner shall provide the Contractor with copies of the borehole geometry and deviation survey logs. The purpose of the borehole geometry and deviation survey is to determine if the pilot borehole is sufficiently plumb and straight to enable reaming and construction of the supply well that will meet the standards for plumbness and alignment set forth in Section 1.04 QUALITY ASSURANCE. Unless otherwise approved by the Owner, the Contractor shall not proceed with further additional work unless, upon completion of the borehole geometry and deviation survey, the pilot borehole is demonstrated to meet the standard for plumbness set forth herein. If the pilot borehole does not meet the standards for plumbness, and the Contractor states that the borehole cannot be corrected through reaming, the Owner may direct the Contractor to, at the Contractor's sole expense, abandon the borehole in accordance with the requirements of Section 3.08 PILOT BOREHOLE ABANDONMENT, redrill the pilot borehole at a location approved by Engineer and Owner, and reimburse Owner for the cost of the borehole geometry and deviation survey by way of a credit on Contractor's next invoice to Owner.

3.07 PILOT BOREHOLE GEOPHYSICAL TESTING

A. GENERAL:

The Owner will arrange and contract separately for conducting a borehole geophysical testing program for the pilot borehole. The Contractor shall cooperate fully and assist as required in conducting the geophysical testing.

Upon drilling to the total depth as directed by the Owner or Engineer, the Contractor shall continue to circulate borehole fluids until all drill cuttings have been removed from the borehole, the drilling fluid in the hole is uniform, and the geophysical services technician is on location or en-route to the project location, as approved by Engineer. With approval from the Owner or Engineer, the Contractor shall remove the drill string from the hole and shall remain on site, to assist as required, until the Owner releases the geophysical testing service provider from the site. The time after completely removing the drill pipe, stabilizer, and bit from the hole until the geophysical testing service provider is released from the site shall be regarded as standby time in accordance with Section 1.05 SCHEDULING.

In the event that geophysical testing cannot be performed over the total depth drilled, as recorded in the Contractor's Driller's Log, the Owner shall receive a credit from the Contractor in the form of a reduction in the total feet charged for pilot borehole drilling (Bid Item 9) equal to the difference between the total depth drilled minus the total depth available for geophysical testing.

B. PROTECTION OF PILOT BOREHOLE AND FORMATION INTEGRITY:

Upon completion of borehole geophysical testing, the Contractor shall protect the integrity of the pilot borehole, and the hydraulic properties of the formation in the vicinity of the pilot borehole, throughout its total drilled depth. This may entail backfilling the pilot borehole with a pumpable bentonite slurry, or other means deemed necessary and appropriate by the Contractor.

C. PAYMENT:

No separate or additional payment shall be provided for the borehole geophysical testing except for any standby time as specified herein. Payment therefore shall be included in the various bid items of work. See Article 15 of Section 00700 for Payment terms.

3.08 PILOT BOREHOLE ABANDONMENT

A. GENERAL:

Upon determination that the borehole should be abandoned for failure to meet the plumbness requirements set forth in Section 1.04 QUALITY ASSURANCE, the Contractor shall furnish all material, equipment, and necessary permits and perform all labor to properly abandon the borehole in accordance with guidelines provided by DWR Bulletin Nos. 74-81 and 74-90 and as specified herein. The goal of abandonment is to restore the hydrogeologic conditions that existed before the hole was drilled.

B. METHOD:

Unless approved otherwise in writing by Owner or Engineer, and in addition to other requirements specified in DWR Bulletin Nos. 74-81 and 74-90, the entire borehole will be filled with neat cement, sand/cement grout or concrete placed from the bottom upward by methods that will avoid segregation or dilution of material.

C. RECORDS:

The Contractor shall submit to the Owner and Engineer complete records of the entire abandonment procedure to provide a record that the hole was properly sealed. The records shall include the type and quantity of sealing material, the depth at which the sealing materials were placed; and measurements of static water levels.

D. PAYMENT::

No payment shall be made for pilot borehole abandonment that is necessary due to Contractor's failure to drill a borehole in accordance with the plumbness requirements set forth in Section 1.04 QUALITY ASSURANCE. See Article 15 of Section 00700 for Payment terms.

3.09 BOREHOLE REAMING

A. GENERAL:

The work described in this section consists of furnishing all material and equipment and performing all labor for reaming the pilot borehole to the total reamed borehole depth and diameter specified herein and on Drawing W-1. The reamed borehole shall be of sufficient diameter to accommodate a 14-inch outer diameter casing and screen assembly plus a minimum four (4) inch thick gravel envelope (filter pack) around the screened intervals, and a 2-7/8 inch outer diameter filter pack feed pipe extending from the ground surface to the top of the filter pack interval.

B. METHOD:

The pilot borehole shall be reamed from the bottom of the permanent conductor casing to the total borehole depth shown on Drawing W-1 to a final diameter of 22 inches using the reverse mud rotary drilling method.

Reaming shall be conducted in a manner that allows for a sufficiently straight and plumb borehole and well installation to meet the requirements of Section 1.04 QUALITY ASSURANCE.

C. DRILLING FLUID:

The requirements for drilling fluids set forth in Section 2.01 DRILLING FLUIDS shall apply to borehole reaming, unless otherwise approved by Engineer. The Contractor shall collect and test samples of drilling fluids using the methods and frequency described in Section 3.02 SAMPLING. Drilling fluid data shall be provided to the Owner and Engineer.

D. PAYMENT:

Payment for borehole reaming shall be in vertical feet drilled at the depths directed (Bid Item 10). Payment shall include full compensation for furnishing all labor, materials, tools and equipment, and the performance of all work in accordance with these specifications. See Article 15 of Section 00700 for Payment terms.

3.10 PRIMARY WELL CASING AND SCREEN INSTALLATION

A. CENTRALIZERS:

1. Unless otherwise specified by the Owner or Engineer, centralizers shall be installed on the well casing at the depths specified below and shown on Drawing W-1.

2. Centralizer Depths:

Ten feet above the uppermost screen

Ten feet below the lowermost screen

At the midpoint of each blank casing section between screens

See Drawing W-1 for depths of each centralizer.

3. Centralizers shall be welded directly to the well casing. Unless otherwise approved by the Owner or Engineer, each centralizer shall consist of a total of four stainless steel bands four (4) feet in length, spaced at 90-degree intervals around the well. Each band shall be bent so that the middle one (1) foot portion protrudes from the casing a distance equal to the annular thickness, which is four (4) inches. The middle portion of each band shall be parallel to the well casing. The angle of each bend shall be no greater than 45 degrees. Additional centralizers or alternative locations may be used only if approved by the Owner or Engineer prior to commencement of work.

B. JOINTS:

1. WELL CASING TO WELL CASING:

Casing joints shall be straight and watertight and shall be appropriate for the material used so that the resulting joint shall have the same structural integrity as the casing itself. Unless approved otherwise by the Owner or Engineer, all casing joints shall be welded in accordance with AWWA or AWS standards. Welding shall be performed through the use of welding collars consisting of a minimum four (4) inch wide band of the same steel material as the casing, equally overlapping each adjoining section of well casing, with at least three alignment holes. Casing sections shall be clamped straight while welding. A rounded, stainless steel bottom cap of the same thickness as the casing shall be welded to the bottom of the tail pipe.

2. SCREEN TO SCREEN:

Joints between well screen sections shall be welded, shall be straight and sand tight, and shall have the same structural integrity as the screen itself. Welding materials and methods recommended by the screen manufacturer shall be employed. Unless approved otherwise by the Owner or Engineer, all screen to screen joints shall be welded in accordance with AWWA or AWS standards. Welding shall be performed through the use of welding collars consisting of a minimum four (4) inch wide band of the same steel material as the casing, equally overlapping each adjoining section of well casing, with at least three alignment holes.

3. SCREEN TO WELL CASING:

Joints shall be appropriate for the material used so that the resulting joint shall be straight and sand tight, and shall have the same structural integrity as the well casing itself. Welding materials and methods recommended by the screen manufacturer shall be employed. Unless approved otherwise by the Owner or Engineer, all screen to well casing joints shall be welded in accordance with AWWA or AWS standards. Welding shall be performed through the use of welding collars consisting of a minimum four (4) inch wide band of the same steel material as the casing, equally overlapping each adjoining section of well casing, with at least three alignment holes.

C. END FITTINGS

The bottom of the screen shall be fitted with a tailpipe and closed bottom. Unless otherwise specified by the Owner or Engineer, the length of the tail pipe shall be twenty (20) feet, as shown on Drawing W-1.

D. PAYMENT:

Payment for installation of well casing shall be in vertical feet determined as the length set below ground surface plus the finished casing height above ground surface.

Payment for installation shall be on a unit price per foot of length installed (Bid Item 11). Payment shall include full compensation for furnishing all labor, materials (excluding the well casing material itself but including materials for centralizers, collars, and the welded bottom cap at the bottom of the tailpipe), tools and equipment, and the performance of all work in accordance with these specifications. See Article 15 of Section 00700 for Payment terms.

Payment for installation of well screen shall be in vertical feet determined as the summation of the screen intervals over the distance from the top of the tailpipe to the bottom of the riser pipe. Payment for installation shall be on a unit price per foot of length installed (Bid Item 13). Payment shall include full compensation for furnishing all labor, materials (excluding the well screen material itself but including materials for centralizers and collars), tools and equipment, and the performance of all work in accordance with these specifications. See Article 15 of Section 00700 for Payment terms.

3.11 FILTER PACK EMPLACEMENT

A. DELIVERY AND STORAGE:

The filter pack material shall be delivered to the project site upon approval by the Owner or Engineer. The material may be delivered in bags, "supersacks" or in bulk. Contractor shall protect filter pack material from contact with the ground, contamination with foreign materials of any kind, and weather until installed. Materials delivered in bulk shall be stored on a surface covered at a minimum with new, clean two millimeter plastic sheeting or equivalent, and covered on top with similar materials. Material for the filter pack that comes in contact with the ground or contaminated material shall not be used, and Contractor shall protect all materials from contamination until installation.

B. INSTALLATION:

Unless otherwise approved by the Owner or Engineer, the Contractor shall install filter pack materials using a tremie wash method. Filter pack materials shall not be installed by freefall. The material shall be placed to ensure continuity of the filter pack without bridging, voids, or segregation.

C. DISINFECTION:

The filter pack material shall be disinfected by treatment with a chlorine solution having a concentration of at least 50 milligrams per liter (mg/L) of available chlorine during installation.

D. PAYMENT:

Payment for filter pack material installation shall be on a per foot basis for installation. Installation shall include full compensation for furnishing all labor, materials (excluding the filter pack material itself but including the filter pack feed pipe), tools, and equipment and the performance of all work in accordance with these specifications (Bid Item 15). See Article 15 of Section 00700 for Payment terms.

3.12 FILTER PACK FEED PIPE INSTALLATION

A filter pack feed pipe shall be installed extending to the depth shown on Drawing W-1. Individual sections of filter pack feed pipe shall be connected by flush-threaded joints.

3.13 INNER ANNULAR SEAL INSTALLATION

A. GENERAL:

The work described in this section consists of furnishing all material and equipment and performing all labor for grouting and sealing in accordance with these specifications and applicable state and local requirements. In general, the grouting and sealing consists of filling, with acceptable sealing material, the annular space between the well casing and the reamed borehole wall over the depth interval from the top of the transition seal described below to the ground surface. Note that the sanitary surface seal outside of the permanent conductor casing, required by California Water Well Standards to be a minimum of 50 feet, shall have been emplaced during installation of the 100-foot outer annular seal under Section 3.03 CONDUCTOR CASING INSTALLATION and 3.04 OUTER ANNULAR (SANITARY) SEAL INSTALLATION, and is therefore not included here.

B. SEALING REQUIREMENTS:

The annular space around the well casing shall be grouted from the top of the transition seal to the ground surface, unless otherwise specified by Owner or Engineer. The annular seal shall be placed between the 22-inch diameter borehole wall and the 14-inch diameter well casing, except that within the upper 100 feet, the grout seal shall be emplaced between the 23-3/8 inch inner diameter conductor casing and the 14-inch diameter well casing. The annular grout seal shall have a thickness of four (4) inches in the portion of the borehole below the conductor casing. In the interval from the bottom of the conductor casing to the ground surface, the grout seal shall completely fill the space (having no gaps or cracks) with continuous adhesion between the main casing and the conductor casing through its entire length.

C. METHODS:

1. Unless directed otherwise by the Owner or Engineer, all sealing material shall be installed in the presence of the Owner or Engineer. The Contractor shall also notify all required authorities, including but not limited to the San Mateo County Environmental Health Department, in advance of the planned sealing material placement, as required by the well drilling permit and all applicable regulations.
2. Unless otherwise approved by the Owner or Engineer, the Contractor shall install the inner annular seal using a tremie pipe in one continuous operation from the bottom of the interval to be sealed, up to the ground surface. Tremie pipe shall be withdrawn during annular seal installation at a rate that ensures that the bottom of the tremie pip remains submerged within grout as it is being emplaced. Sealing material shall be emplaced without freefall, bridging, cement dilution, or sand separation.

D. TESTING:

The Contractor shall verify the proper placement of sealing material by demonstrating that the volume of sealing material placed in the annular space equals or exceeds the annulus volume.

E. PAYMENT:

Payment for grouting and sealing shall be on a per foot basis for installation and a volume basis for grouting and sealing material. Installation shall include full compensation for furnishing all labor, materials (excluding the inner annular seal material itself), tools, and equipment and the performance of all work in accordance with these specifications (Bid Item 17). See Article 15 of Section 00700 for Payment terms.

3.14 WELL PLUMBNESS AND ALIGNMENT TESTING

A. GENERAL:

The completed supply well shall be sufficiently plumb and straight so that there will be no interference with installation, alignment, and operation of a permanent line shaft turbine pump. The supply well shall be constructed and all casings and liners set round, plumb, and true to line as defined herein. If requested by the Owner or Engineer, the Contractor shall demonstrate that the work is in compliance with the requirements set forth herein by conducting a plumbness and alignment test. The Contractor shall furnish all labor, tools and equipment and perform the test or tests described herein.

In the event the plumbness or alignment tests fail to meet the tolerances prescribed herein, the Owner may refuse to accept the supply well and may require the Contractor, at his sole expense, to abandon the existing supply well in accordance with the requirements set forth in Section 3.15 WELL ABANDONMENT and re-drill a new supply well. See Article 14 of Section 00700.

B. METHODS:

1. PLUMBNESS:

The test for plumbness shall be made with an acceptable plummet arrangement. The plummet shall be constructed with either a tripod or drill rig frame assembly. The apex of the assembly shall be stationary with a recommended minimum height of 10 feet above the hole. The plumb ring or plunger shall be heavy enough to keep the plumb line taut and shall consist of a rigid spindle with round plates at both ends. The outer diameter of the end plates shall be one-half ($\frac{1}{2}$) inch smaller than the inside diameter of that part of the casing or hole being tested. The distance between end plates shall be approximately 1.25 times the inside diameter of that part of the casing or hole being tested.

2. ALIGNMENT:

Alignment shall be tested by lowering a section of pipe or dummy to a depth equal to the total depth of the supply well or a depth determined by the Owner. The section of pipe or dummy shall have a length of 40 feet and an outside diameter of not more than one-half ($\frac{1}{2}$) inch smaller than the inside diameter of that part of the casing or hole being tested.

3. WELL GEOMETRY SURVEY:

As an alternative to the plumbness test described in Section 3.14 WELL PLUMBNESS AND ALIGNMENT TESTING, the Contractor may retain the services of a geophysical well logging service provider to conduct an equivalent downhole well geometry and deviation survey at the Contractor's expense.

C. RECORDS:

Upon completion of the well plumbness and alignment testing, the Contractor shall provide to Owner and Engineer all records of the well plumbness and alignment testing.

D. PAYMENT:

Payment for the plumbness and alignment testing shall be made on a lump sum basis (Bid Item 19). See Article 15 of Section 00700 for Payment terms.

3.15 WELL ABANDONMENT

A. GENERAL:

Upon determination that the supply well should be abandoned for failure to meet the plumbness and alignment requirements set forth in Section 1.04 QUALITY ASSURANCE, the Contractor shall furnish all material, equipment, and necessary permits, and shall perform all labor to properly abandon the supply well in accordance with guidelines provided by DWR Bulletin Nos. 74-81 and 74-90 and as specified herein. The goal of abandonment is to restore the hydrogeologic conditions that existed before the well was drilled.

B. METHOD:

Unless otherwise required under the terms of the well abandonment permit, and in addition to other requirements specified in DWR Bulletin Nos. 74-81 and 74-90, the Contractor shall abandon the entire well by pressure grouting, emplacing neat cement by tremie within the well screen and casing assembly from the bottom upwards, using a method that will avoid segregation or dilution of cement.

C. RECORDS:

The Contractor shall provide to the Owner and Engineer complete records of the entire abandonment procedure to provide a record that the well was properly destroyed. The records shall include the type and quantity of sealing material, the depth at which the sealing materials were placed. Records shall include documentation of approval of well destruction by the permitting agency.

D. PAYMENT:

No payment shall be made for supply well abandonment that is necessary due to Contractor's failure to construct a supply well in accordance with the plumbness requirements set forth in Section 1.04 QUALITY ASSURANCE. See Article 15 of Section 00700 for Payment terms.

3.16 WELL DEVELOPMENT

A. GENERAL:

The work described in this section consists of furnishing all necessary pumps, surge blocks, jets, bailers, air equipment, measurement equipment, other material, and other equipment and performing all labor for well development in accordance with these specifications. The supply well shall be developed by a combination of bailing, airlift pumping, swabbing/surging and overpumping, unless other methods are deemed necessary and approved by the Owner or Engineer.

B. METHODS:

1. AIRLIFTING AND SWABBING:

The Contractor shall develop the newly-constructed well using a dual-tube air-development setup. Initially, Contractor shall remove any sediment in the casing (sand or mud) by bailing. Air-development shall proceed without swabs to remove most of the mud and sediment from inside the well casing. After the casing has been cleared to its total depth, the Contractor shall use a dual-swab air-lift apparatus to concentrate development energy within the filter pack over short intervals of well screen, moving the swab in order to sequentially develop all well screens over their entire lengths. The Contractor shall airlift and swab, moving the dual-swab apparatus with repetitive strokes from the top to the bottom of each screened interval, until the development water is visibly cleared of drilling fluid and fine sand.

2. SURGING:

After airlifting and swabbing, development shall include surging the supply well using a flanged or valved surge block. The surging shall be conducted from top to bottom of each screened interval with strokes of no more than five (5) feet. Fines drawn into the supply well shall be measured and removed periodically by pumping or bailing. Surging or swabbing shall be continued for up to 20 minutes total per foot of well screen, or until the fines entering the supply well are decreased to acceptable levels as described under Section 3.16 WELL DEVELOPMENT. After each round of surging, the supply well shall be bailed or airlift-pumped clean of all mud, sand, and sediment.

3. OVERPUMPING:

Upon completion of the surging process, development shall include a series of short periods of overpumping followed by recovery (i.e., "rawhiding") conducted with a pump capable of pumping at rates up to 700 gpm against the system total dynamic head. The pumping shall be carried out in multiple steps with no check valve or foot valve present. Unless determined otherwise by the Owner or Engineer, the multiple steps shall include pumping rates ranging between approximately 150 and 750 gpm against the system total dynamic head. Pumping shall continue at each pumping rate until acceptable standards are attained.

C. INSTALLATION OF PUMP FOR DEVELOPMENT:

1. The Contractor shall furnish, install, operate, and remove an acceptable pump for developing the supply well. The pump shall also be used for subsequent well performance testing and well disinfection. The pump and prime mover shall be capable of operating at different discharge rates, so that the discharge may be varied from 150 to 750 gpm. The pump shall have its intake set at a sufficient depth to conduct the well development and well performance testing specified herein, i.e., at the top of the uppermost screen. The pumping unit shall be complete with an ample power source, controls, and appurtenances and shall be capable of being operated without interruption for a period of up to 72 hours. The Contractor shall furnish and install discharge piping for the pumping unit of sufficient size and length to conduct well development, well performance testing, and well disinfection discharge water to the locations specified in Section 1.07 DISPOSAL OF FLUIDS AND CUTTINGS.
2. Contractor shall install two (2) temporary threaded flush-joint PVC sounding pipes extending from the top of the casing to approximately ten (10) feet above the top of the pump, or to an alternate depth as directed by the Owner or Engineer. Each sounding pipe shall have a minimum inner diameter of 1 inch, and shall be constructed to easily pass a standard electric sounding probe or pressure transducer. Contractor shall remove the sounding pipes upon completion of the well development and aquifer testing activities.

D. COMPLETION OF WELL DEVELOPMENT:

Unless determined otherwise by the Owner or Engineer, well development shall be considered complete upon satisfaction of both of the following conditions:

1. The sand content of the discharge water shall average not more than five (5) mg/L for a complete pumping cycle of two (2) hours duration when pumping at a rate up to 150 percent of the design capacity (i.e., at up to 750 gpm).
2. There shall be no increase in specific capacity during at least three (3) continuous cycles of pumping at a constant rate designated by the Owner or Engineer.

Upon completion of development, the Contractor shall remove any sand, sediment, or other debris accumulated in the bottom of the well casing.

E. MEASUREMENTS DURING DEVELOPMENT:

The Contractor shall record all of the following during development:

1. Time, measured to the nearest minute.
2. Flow rate, measured to the nearest 10 gallons per minute.
3. Pumping water levels before surges (as applicable), measured to the nearest 0.01 foot.
4. The number of surges.
5. Start and stop time, and duration of each swabbing, surging, or pumping cycle.
6. Sand production per pumping cycle, to the best precision practicable using the Rossum-type sand tester.
7. Any observation of unusual or changed conditions, including changes in rate of drawdown, changes in pump behavior or operation, unusual odors, gases, color or sediment load changes in produced water, or other conditions.

Unless approved otherwise by the Owner or Engineer, all measurements of the sand content shall be conducted using a Rossum centrifugal sand sampler.

F. DISCHARGE WATER:

Well development discharge water shall be disposed of in accordance with Section 1.07 DISPOSAL OF FLUIDS AND CUTTINGS.

G. RECORDS:

Complete records of all development work shall be maintained by the Contractor and provided to the Owner and Engineer upon request. See Section 1.08 RECORDS.

H. PAYMENT:

See Article 15 of Section 00700 for Payment terms.

1. WELL DEVELOPMENT BY SURGING OR AIRLIFT:

Measurement and payment shall be by the hour. The price paid per hour shall include full compensation for furnishing all labor, materials, tools, and equipment necessary to develop the supply well by surging or airlifting in accordance with these specifications (Bid Item 20).

2. WELL DEVELOPMENT BY OVERPUMPING:

Measurement and payment for pump operation during well development shall be by the hour of pump operation. The price paid per hour of operation during well development shall include full compensation for furnishing all labor, materials, tools, and equipment required for well development by overpumping in accordance with these specifications (Bid Item 21).

3. FURNISHING, INSTALLATION, AND REMOVAL OF PUMP:

The lump sum price for installation and removal of the pump shall include full compensation for furnishing all labor, materials, tools, and equipment required for installation and removal in accordance with these specifications (Bid Item 22).

3.17 WELL PERFORMANCE TESTING

A. GENERAL:

The work described in this section consists of furnishing all necessary pumps, measurement equipment, discharge piping, other equipment, and other material and performing all labor for performance testing in accordance with these specifications. The pump, measurement equipment, discharge piping, and other equipment shall be the same as used for well development described in Section 3.16 WELL DEVELOPMENT, unless other pumps and equipment are necessary to satisfy the requirements of this specification or as determined by the Owner or Engineer. In general, the Contractor shall be responsible for providing and maintaining the desired

pumping operation schedule and for recording discharge and water level measurements. The Engineer shall specify discharge and time schedules for the performance testing.

B. METHODS:

1. VARIABLE RATE PUMPING TEST:

Upon completion of well development, a variable rate pumping (step-drawdown) test shall be conducted for up twelve (12) hours at rates up to 750 gpm. The variable rate test shall be scheduled to begin when the water level has recovered to static water level as determined by the Owner or Engineer. The time period for recovery to static water level shall equal the duration of the over-pumping operation during development, unless otherwise specified by Owner or Engineer. For this test, the pump shall be operated in stages. Unless determined otherwise by the Owner or Engineer each stage shall have a duration of two (2) hours, and at each successive stage the discharge rate of the pump shall be increased without interruption. Generally, there shall be four (4) stages and the discharge of the first stage shall be one-quarter (1/4) that of the final stage. The discharge of the final stage shall be at least as great as the anticipated constant pumping rate of the supply well, to be determined by the Owner or Engineer. The Contractor shall be responsible for maintaining the desired pump operation schedule.

2. CONSTANT RATE PUMPING TEST:

Upon completion of the variable rate pumping test, a constant rate pumping test shall be conducted. The constant rate test shall be scheduled to begin when the water level has recovered to static water level as determined by the Owner or Engineer. The time period for recovery to static water level shall equal the duration of the pumping operation during the variable rate pumping test, unless otherwise specified by Owner or Engineer. The discharge rate and time duration of the constant rate test shall be designated by the Owner or Engineer and, in general, shall be 600 gpm for 72 hours, unless otherwise specified by Owner or Engineer. Contractor shall maintain the discharge rate within plus or minus five percent (5%) of the designated rate. Contractor shall check the discharge rate and adjust pump operation, if necessary, every ten (10) minutes during the first hour of pumping, and every hour thereafter. The Contractor shall be responsible for maintaining the desired pump operation.

C. ABORTED TEST:

Failure of pump operation for a period greater than two percent (2%) of the elapsed pumping time shall require suspension of the test until the water level in the pumped supply well has recovered to its original level. Recovery shall be considered complete after the supply well has been allowed to rest for a period at least equal to the elapsed pumping time of the aborted test. The Owner or Engineer shall be the sole judge as to whether recovery after an aborted test is complete. Idle time during recovery as a result of an aborted test shall not be measured as recovery time or standby time (see **Bid Item 28**~~Error! Reference source not found.~~) for payment to the Contractor.

D. RECOVERY TIME:

Time off to allow for water level recovery after pumping is complete in accordance with these specifications shall be designated by the Owner and Engineer as recovery time. During recovery time, the Contractor shall take all necessary measures to protect the supply well from damage or contamination. Idle time required for maintenance or failure of equipment shall not be measured as recovery time. Idle time as a result of weather delays shall not be measured as recovery time. Recovery time shall be based

on one work shift per day regardless of the Contractor's operating schedule. Recovery time will not be paid for Saturdays, Sundays, or national holidays on which work is not customarily performed, unless the Contractor has previously agreed to work on such days.

E. DISCHARGE WATER:

Discharge water shall be disposed of in accordance with Section 1.07 DISPOSAL OF FLUIDS AND CUTTINGS.

F. RECORDS:

The Contractor shall maintain complete records of all performance testing work as specified Section 1.08 RECORDS.

G. PAYMENT:

See Article 15 of Section 00700 for Payment terms.

1. VARIABLE AND CONSTANT RATE PUMPING TESTS:

Measurement and payment shall be by the hour of pump operation. The price paid per hour shall include full compensation for furnishing all labor, materials, tools, and equipment necessary to conduct the variable rate (Bid Item 23) and constant rate (Bid Item 24) pumping tests in accordance with these specifications.

2. RECOVERY TIME:

Measurement and payment shall be by the hour for recovery time designated by the Owner in accordance with these specifications (Bid Item 25).

3.18 WELL DISINFECTION

A. GENERAL:

The work described in this section consists of furnishing all material and equipment and performing all labor for well disinfection in accordance with these specifications. The Contractor shall disinfect the supply well at the beginning of the variable rate testing. The Contractor shall also disinfect the supply well periodically during construction as required and as requested by the Owner or Engineer.

B. METHOD:

The supply well shall be disinfected using a solution of fresh water and acceptable chlorine compounds. The chlorine solution used for disinfecting the supply well shall be of such volume and strength and shall be applied so that a concentration of at least 50 mg/L of available chlorine shall be obtained for the entire depth of the supply well at static conditions. All well surfaces above the static water level shall be completely flushed with the solution resulting in a wetted condition for a period of not less than 20 minutes. The disinfecting solution shall remain in the supply well for a period of at least 24 hours. After the 24-hour contact period, the supply well shall be pumped until the presence of chlorine is no longer detectable. Disinfection shall be considered completed upon obtaining successful laboratory results from samples prescribed herein.

C. DISCHARGE WATER:

Discharge water produced during well disinfection shall be disposed of in accordance with Section 1.07 DISPOSAL OF FLUIDS AND CUTTINGS.

D. TESTING:

Upon completion of performance testing, a water sample will be collected by the Owner or Engineer for laboratory analysis to evaluate chemical characteristics of the groundwater. If the sample shows bacteriological contamination, the Contractor shall

either repeat the disinfection method prescribed herein or conduct an overdosing treatment. In the overdosing treatment, the Contractor shall prepare and apply to the entire depth of the supply well a total volume of the chlorine solution equal to at least four (4) times the volume in the supply well and shall allow this solution to remain in the supply well for a period of at least two (2) hours before purging and repeating the sample procedure.

E. PAYMENT:

Payment for completed disinfection shall be on a lump sum basis and shall include full compensation for furnishing all labor, materials, tools and equipment, and the performance of all work in accordance with these specifications (Bid Item 26). See Article 15 of Section 00700 for Payment terms.

3.19 WELL VIDEO SURVEY:

A. GENERAL:

The work described in this section consists of furnishing all material and equipment and performing all labor for performance of a video survey of the completed supply well in accordance with these specifications. The Contractor shall perform the video survey upon completion of the well performance testing. The video survey shall be performed to assess conformance of the supply well with these specifications with respect to the following: 1) total depth of the supply well, 2) depth of the top and bottom of the supply well screen, 3) the condition of the installed supply well casing and well screen, 4) presence of voids in the welded joints of the supply well casing and well screen, 5) presence of mud or incrustation in the supply well screen, and 6) the presence of filter pack material or other debris within the tailpipe section of the supply well.

B. METHODS:

The Contractor shall use a calibrated drawworks to lower a video camera apparatus to the total supply well depth (downhole run) in a controlled manner and raise the apparatus back to the surface (uphole run). The drawworks shall be calibrated to be accurate within one (1) percent of the measured depth. The Contractor shall verify calibration of the drawworks upon request. The depth value on the drawworks shall be set to zero at the ground surface. The video camera apparatus shall consist of color video cameras for both downward-looking and side-looking views and shall be equipped with centralizers. On the downhole run, the camera shall be operated in downward looking mode and on the uphole run the camera shall be operated in a side-looking mode, or as otherwise specified by Engineer. The maximum vertical speed of the apparatus during both downhole and uphole runs shall be 30 feet per minute. On the uphole run each casing joint shall be inspected over its entire 360-degree circumference. Immediately upon completion of the video survey, the Contractor shall provide two (2) copies of the video survey to the Owner and Engineer in DVD format.

C. PAYMENT:

Payment for the well video survey shall be on a lump sum basis and shall include full compensation for furnishing all labor, materials, tools and equipment, and the performance of all work in accordance with these specifications (Bid Item 27). See Article 15 of Section 00700 for Payment terms.

LIST OF BID ITEMS

- Bid Item 1 Mobilization/Demobilization
- Bid Item 2 Disposal of Drill Cuttings and Settled Solids from Well Development
- Bid Item 3 Disposal of Disinfection Water
- Bid Item 4 Drilling of Conductor Casing Borehole
- Bid Item 5 Conductor Casing Installation
- Bid Item 6 Conductor Casing Materials
- Bid Item 7 Outer Annular Seal Installation
- Bid Item 8 Outer Annular Seal Materials
- Bid Item 9 Pilot Borehole Drilling
- Bid Item 10 Pilot Borehole Reaming
- Bid Item 11 Supply Well Casing Installation
- Bid Item 12 Supply Well Casing Materials
- Bid Item 13 Well Screen Installation
- Bid Item 14 Well Screen Materials
- Bid Item 15 Filter Pack Installation
- Bid Item 16 Filter Pack Materials
- Bid Item 17 Inner Annular Seal Installation
- Bid Item 18 Inner Annular Seal Materials
- Bid Item 19 Plumbness and Alignment Testing
- Bid Item 20 Well Development by Surging or Airlift
- Bid Item 21 Well Development by Overpumping
- Bid Item 22 Furnishing, Installation, and Removal of Pump for Well Development
- Bid Item 23 Variable Rate Pumping Tests
- Bid Item 24 Constant Rate Pumping Tests
- Bid Item 25 Recovery Time for Pumping Tests
- Bid Item 26 Well Disinfection
- Bid Item 27 Well Video Survey
- Bid Item 28 Standby Time

END OF SECTION

SECTION 02700
PAVING AND SURFACING

PART 1 - GENERAL

1.01 SUMMARY

- A. Furnishing all labor, material, equipment, tools, and services required for the placing and compacting of asphalt concrete pavement for airfields, roadways, parking lots, and walkways to the lines, grades, and dimensions shown on the Drawings and as specified herein.
 - 1. Also included shall be the repair and resurfacing of existing roadway and area paving damaged or removed during construction.
 - 2. Also included shall be applying penetration treatment to aggregate base surfaces shown on the Drawings.

1.02 REFERENCE SPECIFICATIONS

- A. Whenever the words "Standard Specifications" are referred to, the reference is to the State of California, Department of Transportation, Standard Specifications dated May 2006 (or latest edition).
- B. ASTM International (ASTM):
 - 1. D422 Test Method for Particle-Size Analysis for Soils
 - 2. D1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - 3. D2027 Specification for Cutback Asphalt (Medium Curing Type)
 - 4. D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- C. California Department of Transportation (CALTRANS):
 - 1. California Test 216 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates
 - 2. California Test 231 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates by the Area Concept Utilizing Nuclear Gauges

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit the following under the Product Information category.

1. Samples: Furnish, without additional cost to the Owner, such quantities of construction materials as may be required by the Engineer for test purposes. The Contractor shall cooperate with the Engineer and furnish necessary facilities for sampling and testing of all materials and workmanship. All materials furnished and all work performed shall be subject to rigid inspection, and no materials shall be used in the construction work until it has been inspected by the Engineer.
2. Submit a signed verification from each source of supply for each construction material employed on this project indicating that the materials meet the Specification requirements.
3. Mix design for asphalt concrete.
4. Submit manufacturer's certification of the actual volatile organic compound (VOC) content for all pavement paints and bituminous pavement sealers proposed for use on this project. Submit certification of the actual VOC content for coatings manufactured after 1 September 1987. For coatings manufactured before 1 September 1987, submit VOC content and date of manufacture. VOC content shall be measured in grams per liter by weight of coating as applied excluding water and color added to the tint base.
5. Submit verification that bituminous pavement sealers and paint products furnished meet applicable Bay Area Air Quality Management District (BAAQMD) regulations as to allowable VOC content for the time and place of application and use intended.

1.04 QUALITY ASSURANCE

- A. Comply with "Standard Specifications" of State of California, Department of Transportation (CALTRANS, most recent edition).
- B. All pavement stripe painting shall be performed by competent and experienced Equipment operators and painters using proper equipment, tools, stencils, templates, and shields in a workmanlike manner.

1.05 REGULATORY REQUIREMENTS

- A. All work, material, procedures and practices under this Section shall conform to requirements of the California Air Resources Board (CARB) and the BAAQMD.

PART 2 - PRODUCTS

2.01 ASPHALT CONCRETE

- A. Asphalt Concrete Type B shall conform to the applicable requirements of Section 39 of the Standard Specifications. Asphalt binder shall be paving asphalt or liquid asphalt (cutback). Mineral filler shall consist of portland cement or mechanically reduced rock. Proportioning shall be as set forth in Paragraph "D" below.
- B. Paving asphalt PG 64-10 conforming to the requirements of Section 92 of the Standard Specifications shall be used as the asphalt binder. Bitumen ratio shall be

selected by the supplier in accordance with the tests specified in Paragraph 39-3.04 of the Standard Specifications.

- C. Liquid asphalt (cutback) MC-800 or SC-800 conforming to the requirements of Section 93 of the Standard Specifications shall be used as the asphalt binder.
- D. Mineral filler shall be mechanically reduced rock, conforming to the following gradations when tested in accordance with ASTM D422:

Particle Size	Percentage
Passing No. 200 sieve	75-100
Finer than 0.05 mm	65-100
Finer than 0.02 mm	35-65
Finer than 0.01 mm	26-35
Finer than 0.0005 mm	10-22

- E. Mix Design:

Mix	Type	Grade	Binder Content (%)
Normal	A	3/4" max.	4.5 to 6.5
Patching	A or B	No. 4 max.	4.8 to 7.5
Open graded	--	3/8" max.	5.0 to 8.0

2.02 TACK COAT

- A. Material for tack coat shall be SS-1, grade emulsified asphalt conforming to Section 94 of the Standard Specifications.

2.03 FOG SEAL

- A. Fog seal shall be SS-1 asphaltic emulsion fog seal conforming to the requirements of Sections 37 and 94 of the Standard Specifications.

2.04 PRIME COAT (PENETRATION TREATMENT)

- A. Material for prime coat shall be liquid asphalt SC-70 conforming to the requirements of Sections 92 and 93 of the Standard Specifications and ASTM D2027.

2.05 NOT USED

2.06 HEADERS

- A. At straight sections, wood headers shall be constructed of 2-inch by 8-inch construction heart redwood, held in place by 2-inch by 4-inch stakes, of the same materials, 2 feet long and set at 8-foot centers.
- B. At curved sections, wood headers shall be constructed of three 1/2-inch by 4-inch construction heart redwood bender boards. Boards shall be lapped at one-third of the length of individual boards, with no two boards lapped at the same place. Hold boards in place with stakes same as above.

2.07 AGGREGATE BASE

- A. Aggregate base shall conform to the applicable requirements of the Standard Specifications Section 26, for Class 2 or 3 aggregate base. The aggregate base shall conform to that specified for the ¾-inch maximum, unless otherwise indicated. Paragraphs 26-1.06 and 26-1.07 are not applicable.

2.08 NOT USED

2.09 NOT USED

2.10 TEMPORARY PAVEMENT (COLD MIX)

- A. Temporary pavement shall consist of No. 4 sieve maximum aggregate size, graded in accordance with Section 39 of the Standard Specifications. The aggregate shall be blended with 5-8% SC-800 liquid asphalt.

2.11 LIQUID ASPHALT DISTRIBUTOR

- A. The distributor used in applying all liquid asphalt shall be of the self-propelling type, of sufficient power and capacity to apply the asphalt under pressure uniformly and at the proper rate with not more than 10% variation therefrom. The distributor shall be equipped with tachometer and charts, pressure gauge, thermometer well, and thermometer; and shall have adjustable length spray bars of sufficient length to cover one-half of the roadbed at one time. The spray bars shall be adjustable vertically to permit application of the asphalt at the height above the surface approved by the Engineer and shall be of the full-circulating type with satisfactory cutoff device at each nozzle. The use of trailer-type distributors shall not be permitted.
- B. A trough shall be located under the sprays, properly arranged to be swung out of the way after the sprays are operating in a uniform manner at the desired pressure or, in lieu thereof, building paper shall be spread over the treated surface for a sufficient length back so that the sprays are operating properly when the uncovered surface is reached. The building paper shall then be removed and disposed of. If the cutoff is not sufficiently positive, the similar use of paper may be required at the end of the area being covered. The distributor shall be operated in such a manner that liquid asphalt will not be splashed on adjacent guardrails or structures. Any asphalt so splashed may be removed at the expense of and by the Contractor.
- C. Contractor may use other methods of distributing liquid asphalt if agreeable to the Owner.

PART 3 - EXECUTION

3.01 GENERAL

- A. This Specification shall cover newly paved areas as well as existing pavement restoration.

- B. Where trenching or other construction activity has resulted in damage to a localized area of pavement, the damaged pavement shall be cut back 6 inches and shall be removed and replaced.
- C. Where the damaged area extends over more than 50% of the road width or paved area, as determined by the Engineer, the full pavement width or area shall be cut away, removed and repaired.
- D. Structures such as valve boxes, manhole frames and covers, and electrical vaults shall be adjusted to grade as necessary within paved areas.
- E. Existing asphalt pavement islands of 50 ft² or less and strips 18 inches or less in width shall be removed and replaced.
- F. Adjust existing manholes, meter boxes, cleanouts, etc. to match the new grade.

3.02 PAVEMENT CUTTING

- A. After backfilling and prior to paving, proper tools and equipment shall be used in marking and breaking so that the pavement shall be cut accurately and on neat lines parallel to the trench. The asphalt pavement shall be saw cut (using a concrete saw) to a minimum depth equal to or greater than one-half the thickness thereof. The pavement shall be cut back 6 inches on each side of the trench or excavation wall. Any pavement damaged outside these lines shall be re-cut and restored at the expense of the Contractor. Should voids develop under existing pavements during construction, those affected pavements shall be neatly saw cut in straight lines and replaced after the voids have been filled.
- B. Construct joints between successive runs vertical and at right angles to the line of the improvement. Exercise care in construction of all joints to ensure that the surface of the pavement is true to grade and cross-section. Lapped joints will not be permitted.

3.03 PLACEMENT OF AGGREGATE BASE

- A. Subgrade Preparation: The subgrade shall be watered or dried as required to bring the soil, as close as practicable, to the optimum moisture content for proper compacting and then compacted, as specified, to a relative compaction of not less than 95% in the upper 6 inches. When compaction of the subgrade areas on fill and embankments has been properly obtained, only such additional rolling will be required as necessary to obtain a thoroughly compacted subgrade immediately prior to placing the aggregate base thereon.
- B. Aggregate Base Tolerance: The aggregate base shall not be placed before the subgrade is approved by the Engineer. The finished aggregate base shall not vary more than 0.05-foot above, nor 0.10-foot below, the planned grade.
- C. Aggregate Base Placing: The aggregate base material shall be spread on the prepared subgrade by means of approved spreading devices subject to approval by the Engineer; the aggregate base material may be dumped in piles upon the subgrade and spread by bulldozing ahead from the dumped material. Each layer shall not exceed 0.50 feet. Segregation of large or fine particles of aggregate shall

be avoided, and the material as spread shall be free from pockets of large and fine material.

- D. Compaction: The relative compaction of each layer of compacted aggregate base material shall not be less than 95% as determined by California Test 216 or ASTM D1556 (Sand Cone), or California Test 231 or ASTM D2922 (Nuclear method when approved by the Engineer). Compaction shall be in accordance with Section 26-1.05 of the Standard Specifications. Aggregate base, after compaction, shall be watered as provided in Section 17 of the Standard Specifications. Paragraph 17-1.04 is not applicable.

3.04 PRIME COAT APPLICATION

- A. Prime Coat: In advance of spreading paving materials, a prime coat of liquid asphalt shall be applied to all base course surface areas to be covered with asphaltic concrete.
 - 1. Preparation of Base Course: Immediately before applying the prime coat, the area to be surfaced shall be cleaned of all loose material by means of hand brooms.
 - 2. Application: Liquid asphalt shall be applied by pressure distributors at a temperature between 125 and 200°F. The Engineer reserves the right to require an adjustment of the temperature of the liquid asphalt at the time of placement. The rate of application shall be between 2/10 and 3/10 gallon per square yard. Excess liquid asphalt, which has failed to penetrate the base, shall be covered with fine sand. All loose sand shall be removed from the treated areas before placing any surfacing material thereon. Liquid asphalt shall not be applied when the atmospheric temperature is below 50°F. The prime coat shall be applied at least 24 hours in advance of paving. Immediately in advance of paving asphalt concrete surfacing, additional prime coats shall be applied, as directed by the Engineer, to areas where the prime coat has been damaged.

3.05 TACK COAT APPLICATION

- A. Tack Coat: In advance of spreading bituminous material upon an existing bituminous or portland cement concrete surface, a tack coat shall be applied to all areas to be surfaced and to all vertical surfaces of existing pavement, curb, gutters and construction joints in the surfacing against which additional material is to be placed. When two or more lifts of asphaltic concrete are required, a tack coat shall be applied between each lift.
 - 1. Preparation: Immediately before applying a tack coat, the area to be surfaced shall be cleaned of all loose material.
 - 2. Application: The tack coat shall be applied by means of pressure distributors by pressure hand-spray equipment. The rate of application shall be 1/20 gallon per square yard. Emulsified asphalt shall not be applied when the atmospheric temperature is below 40°F. If emulsified asphalt Type SS-1 is used, it may be diluted with an equal part of water. The rate of application of the dilution shall be such that the rate of application of undiluted emulsion shall be within the tolerances specified.

3.06 PLACEMENT OF ASPHALT CONCRETE

- A. Delivery and Spreading: Bituminous mixtures shall be delivered to the roadbed at temperatures specified in the Standard Specifications. Spreading of the mixture shall be in accordance with Section 39 of the Standard Specifications. Paragraph 39-8 does not apply. All loads shall be covered with tarpaulin or other material during transportation. The top layer of asphalt concrete shall not exceed 0.20 feet in compacted thickness. The next lower layer shall not exceed 0.25 feet in compacted thickness, and any lower layers shall not exceed 0.50 feet in compacted thickness.
- B. Compaction: Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be compacted in accordance with Section 39 of the Standard Specifications. Paragraph 39-8 does not apply. Compaction by vehicular traffic shall not be permitted. The Engineer reserves the right to require an adjustment of the temperature of the asphalt concrete at the time of placement.
- C. Pavement Thickness: Pavement shall match the existing adjoining pavement in thickness, or as indicated on the Drawings, or as specified, whichever is greater.
- D. Joining Pavement: The joints between old and new pavements or between successive days' work shall be carefully made in such manner as to ensure a continuous bond between old and new sections of the course. Edges of existing pavement shall be exposed and cleaned and edges cut to straight, vertical surfaces. All joints shall be painted with a uniform coat of tack coat before the fresh mixture is applied.
- E. Protection of Pavement: After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened and in no case less than 6 hours.

3.07 APPLICATION OF FOG SEAL

- A. A fog seal shall be applied to the upper surfaces of all installed asphalt concrete. It shall be applied in accordance with the applicable requirements of Section 37, BITUMINOUS SEALS, of the Standard Specifications, Seal Coats. Subparagraphs 37-1.08 and 37-1.09 are not applicable.

3.08 PAVEMENT RESTORATION

- A. Final pavement restoration shall be made as soon as practicable after backfilling. In that period of time between backfilling and final pavement restoration, the trench shall be maintained level with the adjacent pavement and shall be covered with a 1-inch minimum layer of cutback. Prior to placing the final pavement, the temporary pavement shall be removed, the aggregate base excavated to the lines indicated on the Drawings, and the existing pavement edges saw cut as herein specified. The final asphalt pavement shall not be placed before the primed aggregate base surface is approved by the Engineer.

3.09 PENETRATION TREATMENT APPLICATION

- A. Preparation of Base Aggregate Surface: Immediately before applying the first coat of the penetration treatment, the area to be treated shall be cleaned of all loose material.
- B. Application:
 - 1. The penetration treatment shall be applied in three applications. The first application shall be applied at the rate of 0.5 gallon per square yard, and the second and third applications shall be applied at the rate of 0.25 gallons per square yard. The second and third application shall be placed two to three weeks apart as approved by the Engineer and after the previous applications have thoroughly penetrated the base.
 - 2. Liquid asphalt shall be applied by pressure distributors at a temperature between 140 and 255°F. The Engineer reserves the right to require an adjustment of the temperature of the liquid asphalt at the time of placement. Excess liquid asphalt, which has failed to penetrate the base in the third application, shall be covered with fine sand. Liquid asphalt shall not be applied when the atmospheric temperature is below 50°F.

3.10 NOT USED

3.11 HEADERS

- A. Install wood headers along pavement edges bordered by soil. Install new headers where existing wood headers are damaged during construction, or removed for construction. Install headers with uniform slope between spot elevation indicated on the Drawings or to conform to existing grades.

3.12 PAVEMENT MARKINGS

- A. Preparation: Immediately before applying the paint, the pavement surface shall be thoroughly cleaned of all dust, dirt, scale, curing compound, oil, grease, or other objectionable matter as directed by the Engineer. Solvent material that will damage the pavement shall not be used as a cleaning agent.
- B. Tolerances: Marking and striping shall be within 2 inches of the correct alignment. Dimensions of marking and stripings shall be within ½-inch.
- C. Mixing: Mechanical mixers shall be used to mix paint. Prior to applying, the paint shall be mixed a sufficient length of time to thoroughly mix the pigment and vehicle together, and shall be kept thoroughly agitated during its application.
- D. Application: Pavement marking shall be applied only on dry surfaces and only during periods of favorable weather. Painting shall not be performed when the atmospheric temperature is below 40°F when using solvent-borne paint or below 50°F when using water borne paint; when freshly painted surfaces may become damaged by rain, fog, or condensation; nor when it can be anticipated that the atmospheric temperature will drop below said 40°F or 50°F temperatures during the drying period.

1. Immediately following the preparation of the pavement, the paint shall be applied. The paint shall be applied at the rate of 100 to 110 square feet per gallon of paint. The stripe painting machine shall have a compressor capacity of at least 105 cubic feet per minute and be capable of operating at an air pressure of 125 psi. The paint shall be mechanically agitated while the machine is in operation. The striping machine shall be equipped with a guide post so designed that the machine will hold exactly to the alignment. The propelling vehicle shall be equipped with a guide post so designed that the machine will hold exactly to the alignment. The propelling vehicle shall be equipped with a speedometer or tachometer, and with a suitable device for determining the quantity of paint in the container. The paint container and spray nozzles on the machine shall be thoroughly cleaned before starting each day's work. The stripe shall be of the required width, with clean, true edges and without sharp breaks.
 2. Allow 10 days between the application of a bituminous seal coat and the permanent pavement marking. The paint shall not bleed, curl or discolor when applied to bituminous surfaces. If bleeding or discoloring occurs, apply an additional coat of paint.
 3. Remove existing permanent or temporary markings and striping which are to be abandoned or obliterated, by wet sandblasting or other favorably reviewed methods. Dry sandblasting may be used in selected areas only with prior approval of the Engineer and with approval of the air pollution control authority having jurisdiction over the area in which the work will be performed. Obliteration of traffic striping with black paint or light emulsion oil shall be done only with the prior favorable review shall not be used as a removal agent.
- E. Provide all warning devices required to protect the painting operation and the finished work. Repaint, to the applicable specifications, any portion of the stripe damaged by any type of traffic within 24 hours after the stripe has been applied. For striping less than 50 feet in length, favorably reviewed portable painting equipment may be used.

END OF SECTION

SECTION 02775

CONCRETE CURB, GUTTERS, AND SIDEWALKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Provide concrete curbs, curbs and gutters, gutters, and sidewalks as shown on the Drawings and as specified herein.

1.2 REFERENCE SPECIFICATIONS

- A. Wherever the words "Standard Specifications" are referred to, the reference is to the most recent version of the State of California, Department of Transportation, Standard Specifications.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit certificate of compliance indicating that the concrete complies with the specifications.

PART 2 - PRODUCTS

2.1 CONCRETE

- A. Comply with Standard Specifications, Section 40.
 - 1. Cement: Type II Modified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with the Standard Specifications, Section 73, Paragraphs 1.02 through 1.06, inclusive.
- B. Unless shown otherwise on the Drawings, replace existing curbs, curbs and gutters, gutters and sidewalks in kind.
- C. Adjust structures such as valve boxes, manhole frames and covers, and electrical vaults to grade after the curb and gutter or sidewalk has been constructed for a reasonable distance on all sides of the structure. Complete the concrete work after the structure is adjusted.

END OF SECTION

SECTION 02820
FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work includes: Furnish and install 8-foot high vinyl coated chain link fence conforming to Section 80-4 of the Caltrans Standard Specifications, Caltrans Standard Drawing A85, and as shown on the drawings and as specified herein. In locations where existing fence is to be replaced or extended, the fence type and size shall match the existing fence as nearly as possible. The materials and workmanship shall conform to these Specifications.
- B. Fence and accessories shall be the product of a single manufacturer.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A53 Specification for Pipe, Steel Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. A121 Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
 - 3. A702 Specification for Steel Fence Posts and Assemblies
- B. State of California, Department of Transportation, Standard Specification (Standard Specification) May 2006.

1.03 NOT USED

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit in the Product Information category complete descriptive information and technical specifications on the chain link fence, gates, gate operators, barbed wire and appurtenances.
- C. Shop Drawings: Indicate layout, grid, spacing of components, post foundation dimensions, hardware anchorage, hardware, and schedule of components.

PART 2 - PRODUCTS

2.01 TEMPORARY FENCING

- A. Temporary fencing shall consist of hot-dip galvanized or painted steel, or pretreated or untreated wood posts and braces of suitable length and strength to provide for cantilever support of 5 strands of barbed wire with top strand placed 4 feet above

the ground surface. Bottom wire shall be not more than 9-1/2 inches above ground surface and the remaining strands between top and bottom strands shall be equally spaced.

- B. Untreated wood posts shall conform to Section 80-3.01B (1) of the Standard Specifications. All other materials for temporary fencing shall conform to the Barbed Wire Fencing paragraph below.

2.02 CHAIN LINK FENCING

- A. All components of fence and gates, including fabrics, stretcher bars, braces, posts, plain wire, and all fittings and accessories, shall be galvanized prior to application of polyvinyl chloride (PVC) coating. Color of PVC coating shall be black.
- B. Fabric shall be PVC coated steel conforming to Section 80-4, of the Caltrans Standard Specifications and to these specifications. The PVC coating shall be extruded on zinc coated steel.
- C. Not used
- D. The wire shall be 9-gauge PVC-coated steel wire.
- E. Tension wire shall be 6-gauge PVC-coated coil spring steel wire.
- F. Top braces shall conform to Caltrans Standard Drawing A85. Coat on the outside with PVC per the "Permafused" system on the "Colorbond" system or an approved equal.
- G. Not used.
- H. Not used.
- I. Fittings: Truss rods, turnbuckles, tension bars, clips, bolts and nuts shall be steel.
- J. Concrete shall be Contractor designed concrete mix.

2.04 GATES

- A. Gates shall be installed in the sizes and at the locations as shown on the Drawings.
- B. Unless shown otherwise on the Drawings, gates for temporary fences and barbed wire fences shall be of the "cowboy" type as detailed for barbed wire fence gateways on the State of California, Department of Transportation, Standard Plans, May 2006, Plan A86.
- C. Rolling Gates: All gate frames shall have diagonal braces installed such that the high end of the braces shall be toward the forward end of the gate as the gate rolls closed (i.e., high end of the braces toward the end of the gate that rolls on the ground and low end of the braces toward the end of the gate that is supported on the adjacent stationary fence). Gates shall have two wheels that travel on two 1-1/4-inch-diameter Schedule 40 galvanized steel pipe rails attached to the adjacent stationary fence. These rails shall have stops to prevent the gate wheels from rolling off the back end of the rails when the gate is fully opened. The opposite end of the

gate shall have a rubber wheel on grade and a grooved wheel that travels on a 2-inch by 2-inch steel angle inverted and set in the pavement.

PART 3 - EXECUTION

3.01 TEMPORARY FENCING

- A. Where it is necessary to temporarily remove or alter portions of the existing fence, the Contractor shall install adequate bracing to maintain original tension in the remaining fence. Temporary fencing shall be installed to maintain security. The fencing shall be of adequate design to prevent inadvertent access by either people or livestock. Upon completion of the work, remove the temporary fencing and rebuild and restore all fences to their original position, or revised position as shown on the Drawings, using all new material. Salvaged existing materials may be used if undamaged and if approved by the Engineer.

3.02 REMOVAL AND SALVAGING OF EXISTING FENCING

- A. General: Fencing shall be removed as noted on the Drawings. The fencing to be removed is in satisfactory condition to be salvaged and relocated.
- B. Salvaging: The Contractor shall remove and stockpile fabric, posts and accessories identified by the Engineer as salvageable in such a manner as to assure that no damage will be incurred. Should the Engineer determine that the salvaged posts have been bent, that the zinc coating on any of the salvaged materials has been scratched, or that the salvaged fencing materials have been otherwise damaged, they shall be replaced by new materials at no cost to the Owner.

3.03 NOT USED

3.04 INSTALLATION OF CHAIN LINK FENCING

- A. Install chain link fencing and gates at the locations shown on the Drawings and in accordance with Section 80-4.02 of the Standard Specifications. Chain link fabric and barbed wire shall be stretched with mechanical equipment.
- B. The area to be fenced shall be uniformly and smoothly finish graded before beginning the fence installation. Fence shall be installed after roadway surfacing has been completed. Except where crossing a drainage ditch, the finish grade shall not deviate from a straight line by more than 3 inches. Where crossing a drainage ditch, a line post shall be provided at the top of slope on each side and the fabric shall follow a straight line between the posts. Within the ditch, short post sections shall be embedded to a depth of 4 feet at a maximum spacing of 12 inches on center across the ditch. Posts shall be long enough to overlap the fabric by 12 inches, and each post shall be fastened to the fabric by a minimum of 3 tie bands.
- C. Corner and end post assemblies and the panels on each side of all gates shall be as detailed on the State of California, Department of Transportation, Standard Plans, May 2006, Plan A85. Line posts at 1,000-foot maximum intervals shall have top braces and cross truss rods with turnbuckles as detailed on Standard Plan A85

even though fabric is stretched with mechanical equipment. Top brace shall remain in place after fence is completed.

- D. All posts shall be embedded into the ground in concrete. Install fence posts at 6-foot maximum spacing in the area of travel of rolling gates. Allow concrete footings to cure for seven days before installing fence.
- E. Fence fabric shall be securely fastened to the outward side of the posts with the lower edge at the ground level. Fencing and gates shall be properly braced to prevent sagging.
- F. Demonstrate that all gates swing smoothly or roll freely without binding or dragging, that all gates are lockable, and that all gate hardware operates properly. Demonstrate that all automatic gate operators function properly.
- G. Surplus excavated material remaining after the fence has been constructed shall be disposed of as specified in Section 01140.

END OF SECTION

SECTION 02900

DISINFECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Disinfect all inside surfaces with which water may come in contact in the following:
 - a. Pipelines
 - b. Tanks
 - 2. Dispose of disinfection solution.
- B. Contractor shall disinfect the pipeline prior to service in accordance with AWWA standard specifications and test the water for total coliform using a State Certified Laboratory to verify no positive bacterial results. The contractor shall prepare a disinfection plan for approval by the California Department of Public Health prior to initiating tie in work to the existing drinking water system.

1.2 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C651 AWWA Standard for Disinfecting Water Mains
 - 2. C652 AWWA Standard for Disinfection of Water Storage Facilities

1.3 SCHEDULING

- A. Schedule and coordinate the work with operating personnel. Once disinfection has been satisfactorily accomplished, no further entry to the interior of the facilities will be allowed unless entry must be made to perform repairs, in which case repeat disinfection on a localized basis at no additional cost to the Owner. The Contractor shall be responsible for maintaining security of the disinfected facilities.
- B. Maintain the existing plant in operation, except when shutdowns are allowed per Section 01010 and Section 01020.
- C. Disinfect pipelines following successful pressure testing.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit a Disinfection Plan in the Product Review category including the procedures, methods, materials and schedules proposed for disinfecting the required surfaces.
- C. Favorably reviewed Disinfection Plan shall also include acceptance by California Department of Public Health.

1.5 QUALITY ASSURANCE

- A. State Certified Laboratory testing related to disinfection will be performed by and paid for by the Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Water: Shall be supplied by Contractor.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide all necessary appurtenances required for the disinfection procedures including taps, temporary piping, connections and shutoff valves. Submit data on appurtenances which will be permanently installed for review by the Engineer.
- B. The Contractor is advised that precautions taken to keep surfaces clean during construction and avoiding the entry of deleterious substances on the work during construction will facilitate achieving the disinfection requirements of this project.
- C. Prior to disinfecting, thoroughly clean accessible surfaces of dust, dirt, foreign matter and deleterious substances remove any oil by contact with absorbents. Use water sprays, steam cleaning, vacuum cleaning, swabbing, hand brushing or a combination of methods and rinsing to effect the cleaning, but do not use any method that will be detrimental to the finish surfaces. Flush inaccessible surfaces clean.

3.2 APPLICATION

- A. After completing all construction activities, disinfect the required surfaces with chlorine solutions in accordance with the following procedures. Following disinfection and flushing, the Owner will take water samples for bacteriological analysis of the water. Provide one (1) week of notice to Owner for collecting samples. If the specified bacteriological requirements are not satisfied, repeat disinfection procedure until the requirements are met.
- B. Large Pipelines:
 - 1. Standard: AWWA C651 as amended herein.
 - 2. Forms of Chlorine: Sodium hypochlorite or calcium hypochlorite
 - 3. Method: Continuous feed.
- C. Small Pipelines:
 - 1. Preparation: Provide the system with a 1-inch minimum service cock or valve or other means to inject chlorine solution at a point within 2 or 3 feet of its junction with the supply source. When system is complete, thoroughly flush it by fully opening every outlet until clear water flows from all of them.
 - 2. Disinfecting Agent: Sodium hypochlorite or calcium hypochlorite in sufficient quantities to produce chlorine concentration of at least 50 parts per million in the system.

3. Disinfecting Procedure:
 - a. Connect a hand-operated pump, or other means of injecting the disinfecting agent, to one-inch minimum service cock or valve or other injection device. Pump must provide a pressure greater than that of supply of system.
 - b. With system completely full of water and supply valve open, proceed to adjust every outlet of system so that a trickle of water flows from each.
 - c. Inject disinfectant slowly and continuously at an even rate, not in slugs, until a test at each outlet shows a free chlorine residual concentration of at least 50 parts per million.
 - d. Close all outlets and valves, including valve connecting to supply line and one-inch minimum service cock on solution injection connection. Maintain condition for 24 hours. After 24 hours, test for residual chlorine at each outlet. The free residual chlorine concentration indicated should be not less than 10 ppm. If the indicated free chlorine concentration is less than 10 ppm, repeat disinfection procedure until an approved result is obtained.
 - e. When the above procedure has been completed to the satisfaction of the Engineer, flush out entire system with fresh water until tests at all outlets show a residual of not more than the chlorine residual in the fresh water being used.

3.3 FIELD QUALITY CONTROL

- A. Chlorine Residual Testing: AWWA C651, Appendix A, DPD Drop Dilution Method, except where otherwise specified. Testing shall be performed by Contractor.
- B. Bacteriological Analyses of Water: After the completion of disinfecting procedure, including the final flushing as described in AWWA C651 and heretofore, the Owner will obtain water samples from this system for bacteriological analyses. Requirements for satisfactory disinfection of water supply are that bacteriological analyses indicate that water samples are negative for coliform organisms, and that Heterotrophic plate count (standard plate count) is less than 100 colony forming units per milliliter. If bacteriological analyses do not satisfy the above requirements, then repeat disinfection procedure until these requirements are met.

3.4 DISPOSAL OF DISINFECTION SOLUTION

- A. Contractor shall be responsible for dispose of disinfection solution.

3.5 PROTECTION OF DISINFECTED STRUCTURES

- A. If required to re-enter a disinfected structure, the work shall be conducted utilizing techniques and work methods as necessary to maintain the disinfected status. This shall include use of disinfected foot coverings, tools, and the like. In the event the Contractor contaminates the facilities, effect decontamination at no additional cost to the Owner.

END OF SECTION

SECTION 02910

FIRE HYDRANTS AND UTILITY STRUCTURES

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Fire hydrants, hydrant burys, joint restraints, break-off risers, and appurtenances.
2. Concrete manholes, curb inlets, drop inlets, reducer and transition slabs, precast concrete vaults, chemical pipeline pull boxes, boxes, splash blocks, grates, frames and covers, catch basin filtration inserts, and appurtenances in drain or underdrain pipelines, storm drains, sanitary sewers, valve pits, for a variety of site infrastructure components and where shown on the Drawings.

- B. Precast utility structures shall be constructed from precast concrete units and appurtenances provided by experienced manufacturers. Custom precast concrete units are required where dimensions and arrangements shown on the Drawings so dictate. All associated cast-in-place concrete shall conform to Contractor determined design and material requirements.

1.02 REFERENCE SPECIFICATIONS

A. American Society of Testing and Materials (ASTM):

1. C478 – Specification for Precast Reinforced Concrete Manhole Sections.
2. C857 – Recommended Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
3. C858 – Specification for Underground Precast Concrete Utility Structures.
4. D1557 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb Rammer and 18-in Drop.

B. American Water Works Association (AWWA):

1. C503 – Wet-Barrel Fire Hydrants.

C. California Department of Transportation Standard Plans and Standard Specifications.

- D. ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300.
- B. Product data and drawings shall be submitted covering precast and cast-in-place concrete utility structures and as a minimum shall include dimensions, certification that it is designed to the required loads, concrete compressive strength, reinforcing steel, unit weights, joint gaskets, joint sealants, coatings, covers, metal fabrications and components, and appurtenances.
- C. Product data and installation recommendations shall be submitted on fire hydrants, burys, break-off check valves, mechanical joint restraints, break-off risers, catch basin filtration inserts and appurtenances.

1.04 QUALITY CONTROL

- A. Unless otherwise noted to the contrary, all precast utility structures, manholes, handholes, grates, covers, frames, and appurtenances shall be designed for a HS20-44 (sometimes abbreviated as HS20 or H-20 on the Drawings) wheel load plus the weight of the soil above (using 120 pcf for the soil weight), impact loads, and hydrostatic loads in accordance with ASTM C857. Wall and element thicknesses specified herein and shown on the Drawings shall be minimum sizes; greater sizes shall be provided if required to meet loadings at no additional cost to the City.
- B. Manholes, handholes, and vaults with floors and covers shall be watertight and hence free of infiltration or exfiltration.
- C. Examine each catch basin (also referred to on the Drawings as drop inlet, curb inlet, and similar terms) and collect measurements for proper ordering of each filtration insert. Note that some catch basins contain discharge piping and inserts shall be sized to accommodate this piping.

PART 2 - PRODUCTS

2.01 FIRE HYDRANTS

- A. Fire hydrants shall be wet barrel, manufactured in accordance with AWWA C503 and the hydrant head shall be made of cast iron. Each hydrant shall have one 4-inch pumper outlet port and two 2 1/2-inch hose outlet ports. Each port shall be individually valved and shall be fitted with National Standard Fire Hose Coupling Screw Threads. Confirm thread type with the local fire authority responding to this facility. Minimum working pressure is 150 psig and minimum test pressure is 300 psig. Protector caps shall be provided for each outlet port, shall be cast iron, fitted with chains to the hydrant barrel, and shall each have an inner gasket. Hydrant head outlet shall be 6-inch. Hydrants shall be compatible for use with

break-off risers. The exterior of all hydrants shall receive a factory primer coat and finish coat of traffic yellow enamel paint (unless another color is indicated on the Drawings). Provide bolts, nuts, gaskets, and other appurtenances needed for installation. Hydrants and wetted appurtenances shall be NSF 61 approved. Fire hydrants shall be Clow 960 series with 2x2.5" hose nozzles and 1x4.5" pumper. Matching City's existing hydrants – no substitutes.

2.02 FIRE HYDRANT BURYS, RESTRAINTS, AND BREAK-OFF RISERS

- A. Provide bolts, nuts, gaskets, and other appurtenance needed for installation of fire hydrants. Fire hydrant burys and break-off risers shall have all wetted surfaces NSF 61 approved. All gaskets shall be NSF 61 certified.

Fire hydrant burys shall be cast iron, wet barrel design, with inlet pipe mechanical joint, matched to break-off check valves, hydrant, and piping provided, and shall be of a length to fit individual hydrant installations. Provide bolts, nuts, gaskets, and other appurtenance needed for installation. Fire hydrant burys shall be Clow. Matching City's existing hydrants – no substitutes

- B. Each fire hydrant bury mechanical joint shall be restrained with a mechanical restraint device. Restraint devices for nominal pipe sizes 3 inch through 48 inch shall consist of multiple gripping wedges or collar incorporated into a follower gland meeting the applicable requirements of ANSI/AWWA C110/A21.10. These devices shall have a minimum working pressure rating of 350 psi for 3-16 inch and 250 psi for 18-48 inch. Ratings are for water pressure and the restraint design must include a minimum safety factor of 2 to 1 in all sizes. Restraint devices shall be listed by Underwriters Laboratories and approved by Factory Mutual. Restraints shall be Megalug Series 1100 produced by EBAA Iron Inc., US Pipe MJ Harness Lok, or approved equal.
- C. Fire hydrant break-off risers shall be scored so as to direct the breakage point to the riser and protect the fire hydrant and buried piping. Provide bolts, nuts, gaskets, and other appurtenance needed for installation. Break-off risers, and appurtenances shall be compatible with the hydrant bury and hydrant provided. The exterior of all break-off shall be provided with a primer coat and finish coat of traffic yellow enamel paint.

2.03 PRECAST REINFORCED CONCRETE MANHOLES

- A. Precast reinforced concrete manhole sections including reducer and transition slabs, risers, grade rings, eccentric and concentric cones, slab tops, covers, transition slabs, and base sections shall conform to ASTM C478. Copolymer polypropylene coated steel manhole steps shall be provided except for sanitary sewer manholes. No manhole steps are required in sanitary sewer manholes unless specifically shown on the Drawings. Minimum inside dimension for manholes shall be 48-inches and eccentric cone top sections shall be provided unless otherwise shown on the Drawings. Wall thickness shall not be less than 5 inches for 48-inch diameter risers and cones.
- B. Bases may be precast or cast-in-place concrete. Cast-in-place concrete shall be designed by Contractor and submitted to Engineer for review. Minimum

concrete base thickness shall be 9 inches unless greater thickness is shown on the Drawings. Minimum (or greater if shown on the Drawings) steel reinforcement shall be #4 bars at 12-inches on center each way, top and bottom mats. The joint between the bottom-most riser section and the base shall include a minimum 4-inch mortar fillet or 4 inches of concrete embedment all around.

- C. Concrete manholes, slabs, covers, and appurtenances shall be by Central Precast Concrete, Hanson Pipe and Products, Utility Vault, Christy Concrete Products, or approved equal.

2.04 MANHOLE COVERS AND FRAMES

- A. Manhole covers and frames shall be cast iron, 24-inches in diameter unless otherwise shown on the Drawings, and be non-rocking. A minimum of one pick or hook hole shall be provided in the cover. Covers shall read "Storm Sewer" or "Storm Drain" for storm drain pipelines, "Sanitary Sewer" for sanitary sewers, and shall be blank for manholes on valve vaults unless otherwise noted on the Drawings. Joining cover and frame surfaces shall be machined. Covers and frames shall be asphalt varnish dipped. Check Drawings for locations where special manhole covers are grated. Large manhole covers (greater than 40-inch) shall include a 22-inch removable center or offset center vented lid.
- B. Manhole covers and frames shall be Neenah, Phoenix Iron Works, South Bay Foundry, D & L Foundry, or approved equal.

2.05 GASKETS

- A. Gaskets between riser sections, cones, and grade rings shall be mastic or rubber. Mastic gaskets shall be K.T. Snyder Ram-Nek, Hamilton-Kent Kent-Seal, Sheller-Globe Tac-Tite, or approved equal. Rubber gaskets shall be to ASTM C361 except natural rubber will not be acceptable. Cross sectional gasket area shall be as recommended by the precast manhole manufacturer for a watertight joint.

2.06 NON-SHRINK GROUT

- A. Grout for use in utility structures shall be non-shrink cementitious grout..

2.07 CURB AND DROP INLETS

- A. Curb and drop inlets shall be precast concrete in accordance with ASTM C858 unless otherwise shown on the Drawings. The inside dimensions of these inlets shall be as shown on the Drawings. These units shall be reinforced concrete designed for the actual depth and installation conditions by the manufacturer. Minimum wall thickness is 4-inches unless a greater thickness is shown on the Drawings. Cast iron or steel grates, frames, and hoods shall be provided as shown on the Drawings. All steel frames and grates shall be hot dipped galvanized. Steel grates shall be banded at the ends of the bearing bars. Pipe openings or knock-out webs shall be provided for the number and diameter of pipes entering the unit as shown on the Drawings.

- B. Curb and drop inlets shall be by Central Precast Concrete, Hanson Pipe and Products, Christy Concrete Products, or approved equal.

2.08 CATCH BASIN FILTRATION INSERTS

- A. Catch basin filtration inserts shall be by Clean Way Storm Clean, Contech Triton, or approved equal. These units shall have a minimum treatment capacity of 40 gallons per minute and capture trash, debris, hydrocarbons, oils and grease and sediment. The filtration media shall be easily removed from inlet for maintenance without use of heavy equipment. Inserts shall be fabricated to fit the various sizes and types of catch basin and catch basin-like structures that are new and existing. Inserts shall accommodate piping that discharges through the wall of the catch basin. This piping's water discharge need not be included in the filtration.

2.09 PRECAST CONCRETE VAULTS, HANDHOLES, AND BOXES

- A. Concrete vaults, handholes, chemical piping pull boxes and vaults, and boxes of various types (including valve stem, cleanout, survey monument, traffic, etc.) shall be reinforced precast concrete and the standard products of a manufacturing company. Vaults and boxes in roads, asphalt pavement, or concrete surfaces shall be designed for HS20-44 loading and furnished with reinforced concrete or hinged galvanized steel covers. Dimensions or types of boxes or vaults shall be as shown on the Drawings. If no dimensions are shown on the Drawings, provide a vault or box with inside dimensions at least 8 inches greater than the outside dimensions of the piping or equipment enclosed and depth as required to match finish grade. Unless otherwise shown, vaults shall be provided with precast concrete floors, frames, covers, sumps, and appurtenances as required for the intended use. Boxes shall have non-settling shoulders and available extensions to increase the overall height of the box. Polyester utility boxes can be used in non-traffic areas. Boxes shall include utility, curb valve, traffic valve, and clean-out boxes.
- B. Vaults deeper than 3-feet, and larger than 3-feet by 3-feet, shall be provided with an aluminum ladder. Refer to Typical Details S701/TYP and S703/TYP included in the Drawings for ladder requirements.
- C. Where shown on the Drawings provide custom aluminum and galvanized steel covers with inspection ports, lifting lugs, labeling, gaskets, and other appurtenances shown.
- D. Vaults shall be by Utility Vault Company, Hanson Pipe and Products, or approved equal. Boxes shall be by Christy Concrete Products, Hanson Pipe and Products, or approved equal.

2.10 SPLASH BLOCKS

- A. Splash blocks shall be tapered precast concrete with nominal dimensions of 24 by 12 inches by 1.5 to 4 inches thick, Christy, Brooks Products, or approved equal.

2.11 CONCRETE VALVE AND MISCELLANEOUS PURPOSE BOXES

- A. Valve and miscellaneous boxes shall be high density reinforced concrete, circular, and rated for HS20 truck loading. Each shall have a belled top to reduce settlement and shall be fitted with a cast iron seat and lid. Lids shall be permanently marked with the box service (i.e., water, sewer, CO, survey, etc.) with raised or recessed letters. Boxes shall be by Christy, Brooks, Hanson, or approved equal.

PART 3 - EXECUTION

3.01 HANDLING

- A. Precast concrete units shall be handled carefully and shall not be dropped or bumped. Damaged sections shall be immediately marked as damaged and removed from the site

3.02 MANHOLE BASE CONSTRUCTION

- A. Cast-in-place concrete or precast concrete shall be placed over an aggregate base fill compacted to 95% relative compaction per D1557 where shown on the Drawings. Aggregate base fill shall be placed upon undisturbed earth or engineered fill. Where aggregate base is not required by the Drawings, place structure on undisturbed native soils. The surface of the aggregate base rock and native soil shall be accurately graded and the base section accurately set or cast so that intersecting pipelines will be at the proper line and grade. No blocking or wedging of precast concrete bases is permitted.
- B. In no case shall the invert of the inlet pipe(s) be lower than that of the outlet pipe(s). All bases and concrete fill shall be sloped to drain. Unless otherwise shown on the Drawings, the outlet pipeline(s) shall have an invert at least 0.1 foot lower than the lowest inlet invert pipeline. Concrete infill shall be provided and the invert of the concrete channels through the manhole shall be troweled smooth, using as large a radius as possible unless specifically shown otherwise on the Drawings.

3.03 MANHOLE RISER AND CONE, VAULT WALL INSTALLATION

- A. All concrete joints shall be cleaned prior to setting sections. Precast risers, cone sections, vault sections, and grade rings shall be provided with mastic or rubber gaskets to seal joints between sections. Mastic gaskets shall be used only within the temperature range and atmospheric conditions recommended by the gasket manufacturer. Lifting holes in precast units shall be completely packed with non-shrink grout after the unit is installed.
- B. All surfaces to receive grout shall be cleaned and wetted before placing grout.
- C. All void spaces between the piping and the manhole shall be completely packed with non-shrink grout.
- D. The maximum height of grade rings shall be limited to 18 inches. Grade rings

shall be secured by concrete blocking.

3.04 MANHOLE FRAME AND COVER INSTALLATION

- A. Frames and covers shall be adjusted to match the grade and cross-slope of the finished surface. Frames shall be embedded in concrete which shall extend outwards a minimum of 12 inches from the frame outside perimeter. In asphalt paved areas, the asphalt paving shall extend over the concrete to the perimeter of the cover. In unpaved areas, the embedment concrete shall be flush with the top rim of the frame and slope away from the cover at 0.25-inches per foot.

3.05 CURB AND DROP INLET INSTALLATION

- A. Curb and drop inlets shall be placed upon a minimum of 8 inches of aggregate base fill compacted to 95 percent relative compaction per D1557. The aggregate base fill shall be placed upon undisturbed earth or engineered fill. Backfill shall be carefully and evenly placed to avoid damage to the inlet and to maintain vertical alignment. Each inlet floor elevation will be accurately placed to match the grade of the lowest pipe invert. Concrete infill shall be provided in each inlet to form a smooth flow path from upstream pipe(s) to the outlet pipe. All lifting holes shall be filled with mortar.

3.06 CATCH BASIN FILTRATION INSERT INSTALLATION

- A. Each catch basin filtration insert shall be constructed according to the dimensions shown on the Drawings and as specified herein. Install at elevations and locations shown on the Drawings or as otherwise directed by the City Representative.
- B. Provide 10 additional catch basin filtration inserts and deliver to City Representative as spare parts. Sizes shall be as directed by City Representative.

3.07 VAULT, HANDHOLE, BOX, AND VALVE BOX INSTALLATION

- A. Vaults, handholes, and boxes shall be placed so that they are flush with paved surfaces and 1 inch above the surrounding grade in unpaved areas. Provide a minimum of 8 inches of aggregate base fill compacted to 95 percent relative compaction per ASTM D1557 under all vaults, handholes, and boxes unless greater thicknesses or other installation conditions are shown on the Drawings. In unpaved areas slope the surrounding 4 feet away from each vault or box.

3.08 FIRE HYDRANTS, BURYS, BREAK-OFF RISERS

- A. Provide bury heights so that the break-off riser is above finish grade and as shown on the Drawings. Install joint restraint. Orient hydrants as shown on the Drawings. Install in accordance with the manufacturer's directions. Hydrants with factory coating damage shall be repainted in the field. Flush each hydrant after installation and confirm that both the hydrant isolation valve is fully open. Operate each hydrant outlet port valve to ensure operation under the operating water pressure and its full range. Protect surrounding property from damage during

flushing and testing using diffusers, plates, and barriers as required.

3.09 LEAKAGE TESTS

- A. Test each sump pump wetwell, and sanitary sewer, storm drain manhole for leakage. City Representative shall observe each test. Perform exfiltration test as described below.
- B. Assemble manhole in place; fill and point all lifting holes and exterior joints. Test prior to backfilling wherever feasible. Lower surrounding ground water table below bottom of the manhole for the duration of the test. Plug all pipes and other openings into the manhole and brace to prevent blow out. Test manholes before electrical, instrumentation, and equipment components are installed.
- C. Fill manhole with water to the top of the cone or cover section. If the excavation has not been backfilled and no water is observed moving down the surface of the manhole, the manhole is satisfactorily water-tight. If the test, as described above is unsatisfactory as determined by the City Representative, or if the manhole excavation has been backfilled, continue the test. A period of time up to 48 hours may be permitted to allow for water absorption. Following this period, refill manhole to the top of the cone, if necessary and allow at least 8 hours to pass. At the end of the test period, refill the manhole to the top of the cone or cover again, measuring the volume of water added. Extrapolate the refill amount to a 24-hour leakage rate. The leakage for each manhole shall not exceed one gallon per vertical foot of structure height above the base for a 24-hour period. If the manhole fails this requirement, but the leakage does not exceed three gallons per vertical foot per day, repairs by approved methods may be made as directed by the City Representative. If leakage due to a defective section of joint exceeds three gallons per vertical foot per day, the manhole shall be rejected and replaced at no additional cost to the City. Uncover the rejected manhole as necessary and to disassemble, reconstruct or replace. Retest the manhole and, if satisfactory, drain and prepare for service.
- D. No adjustment in the leakage allowance will be made for unknown causes such as leaking plugs, absorptions, etc. It will be assumed that all loss of water during the test is a result of leaks through the joints or through the concrete.

3.10 CLEANING

- A. At the end of construction work, thoroughly clean all manholes, vaults, boxes, curb inlets, drop inlets, trench drains, gratings, and frames of test water, plugs, construction debris, dirt, and trash.

END OF SECTION

SECTION 09900

PAINTING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section 09900 covers painting Chemical Storage Area CMU block only. All other painting and coating (e.g., Canopy over this structure. Metallic assets like the Chemical Storage Area Canopy, Hydropneumatic tank and piping) are covered in Section 09960.
- B. Section Includes:
 - 1. A painter's finish on all exterior and interior surfaces, except:
 - a. Integrally finished materials such as ceramic tile, brick, glass, concrete floors, etc.
 - b. Factory finished items such as acoustic panels, acoustic tile, exposed T-grid suspension systems, toilet partitions, anodized aluminum, light fixtures, etc.
 - 2. Prime coat paint all exposed and concealed surfaces of sheetmetal flashings prior to installation.
- C. CMU wall structures require finish painting whose color shall be favorably reviewed prior to performing the work. Contractor and Owner or Owner's representative shall visit the existing Gloria Way Well Treatment Site, located at Gloria Way and Bay St, to review with the Owner the color selections at this existing facility to inform selection at the Pad D Standby Well. After this visit, Contractor shall provide the Owner color samples for areas being painted under this section, which Owner will evaluate and then inform Contractor of selection prior to Contractor providing submittal for favorable review.

1.02 REFERENCES

- A. Where standards of surface preparation are described by citing SSPC specification numbers reference is made to the "Steel Structures Painting Manual" Volume 2 published by the Steel Structures Painting Council.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Contractor Qualifications: Submit a list of at least five projects completed in the past five years where High Performance Coatings similar to those required for this project were applied by the Specialty Painting Contractor proposed for this project.
- C. Product Data:
 - 1. Submit complete technical data on all materials to be used on the project for review prior to ordering material. Include manufacturer's brand name and type of material for each coat of each system to be used.
 - 2. If products manufactured by makers other than the first named product by the first named maker listed in Part 2 of this Section are submitted, submit

supporting performance test results prepared by an independent paint testing laboratory for comparison with the performance of the first named product by the first named maker.

3. If the Contractor's second submittal of a proposed equivalent material is not favorably reviewed the Contractor will be back-charged by the Owner for the cost of subsequent reviews.

- D. Manufacturer's Certification: That products furnished meet applicable Air Quality Management District regulations as to allowable VOC content for the place of application and use intended.
- E. Samples: For paints submit two 8-1/2 by 11-inch brush-outs of each paint system and each color on cardboard. For stains and transparent finishes submit two complete sample finishes on 8-1/2 by 11-inch pieces of the wood that will be used on the project.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: All work, material, procedures and practices under this Section shall conform with requirements of the Federal Standard 40 CFR on air quality control, and the requirements of the local Air Resources Board or Air Quality Management District having jurisdiction. Coatings or primers applied at locations other than the project site shall be done in accordance with local air quality regulations in effect at the place the coating is applied.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in unopened containers with manufacturer's label. Label shall state VOC content.
- B. Store in assigned area. Maintain storage area clean and fire safe. Dispose of used rags and clean buckets daily. Store solvents in closed approved storage containers.
- C. Submerge solvent soaked rags in water.

1.06 PROJECT CONDITIONS

- A. Environmental Requirements:
 1. Provide ambient temperatures recommended by manufacturer of material to be applied.
 2. Provide adequate ventilation.
 3. Provide 40- to 50-foot candles of illumination on all surfaces in areas to be painted including floors, walls and ceiling even though they do not require painting.
 4. Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

1.07 COLORS AND COLOR SAMPLES

- A. As stated above and before starting work, obtain color schedule and samples of colors selected for this project by the Engineer.

- B. Colors are to be factory or machine mixed, using light-fast colorants proportioned by accurate measurement into a proper tinting base. The color formula for each color shall be submitted to facilitate future color matching.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Coatings used shall be "top of the line" and of the type recommended by the manufacturer for the intended use and substrate.
- B. Applicable Air Quality Management District regulations prohibit the manufacture, sale or application of Architectural Coatings and Specialty Coatings having greater than stipulated levels of volatile organic compounds.
- C. The Contractor shall base his bid on using the products specified. If the products specified are not available in formulations that meet applicable Air Quality Management District regulations on maximum VOC levels, the Contractor shall submit products of equivalent quality and function that comply with regulations in effect at that time.
- D. If the Contractor applies any coatings for which it has not submitted certificates indicating the VOC content and that the product complies with applicable Air Quality Management District regulations, or if it applies coatings that have been modified or thinned other than as recommended by the manufacturer, the Contractor shall be responsible for any fines, costs, remedies, or legal actions that may result.
- E. The Contractor shall not submit or use any material containing Trichlorethylene III because of its potential cancer causing properties. If any of the materials specified in this Section contain trichlorethylene, they shall be considered deleted from this Specification.

2.02 SPECIALTY COATINGS: PRIMERS, STAINS, SEALERS AND CLEARS

- A. Products and makers listed establish type of material and level of quality. Equivalent products manufactured by ICI Dulux Paint, Sherwin-Williams, Tnemec, or equal may be submitted for review.
- B. Specialty Coatings: Coatings listed under this category include primers, sealers, stains and clear coatings. All products provided shall comply with the maximum allowable VOC limit assigned to that category of product by the Air Quality Management District having jurisdiction.
 - 1. LATEX BLOCK FILLER
A heavy bodied latex filler for use on interior and exterior porous concrete block masonry. Maximum allowable VOC limit 250. ICI Interior/Exterior Acrylic Block Filler, Bloxfill No. 4000., Sherwin-Williams, or equal.

2.03 ARCHITECTURAL COATINGS

- A. Coatings listed under this category consist of decorative and protective coatings used to protect surfaces and provide color for buildings and other structures. Most

paints and enamels fall under this category. All products used under this category must comply with a VOC limit of 250.

- B. Products and makers listed establish type of material and level of quality. Equivalent products manufactured by Glidden, Sherwin-Williams, ICI Dulux, Devco Coatings, or equal may be submitted for review.
 - 1. FLAT ACRYLIC EXTERIOR MASONRY PAINT
100% acrylic latex flat exterior masonry paint formulated for exterior concrete, concrete unit masonry, stucco and brick. Maximum allowable VOC content 250. ICI Dulux Exterior Acrylic Flat Masonry Finish, Ultra-Hide Durus No. 2220, Sherwin-Williams, or equal.

PART 3 - EXECUTION

3.01 CONDITION OF SURFACES TO BE PAINTED

- A. Examine areas to receive work of this Section. Make certain that surfaces are even, smooth, sound, clean, dry, and free from defects or substances that might affect application.
- B. Arrange for repairs or major cleaning as required. Starting work indicates acceptance of surfaces as satisfactory to achieve required result.

3.02 PREPARATION OF SURFACES

- A. Check that hardware, trim, plates, lighting fixtures and similar items have been removed before starting work; coordinate with work under sections installing such items. Check that equipment adjacent to walls shall be disconnected and moved to permit wall surfaces to be painted before starting work under this Section.
- B. Wash metal surfaces with solvent or cleaner to remove dirt or grease, and clean off rust or scale with wire brush or sandpaper.
- C. Bare or Shop Coated Steel: Remove rust and scale by wire brushing or sandblasting; wash with solvent or cleaner.
- D. Galvanized Steel: Etch with phosphoric solution such as Galvaprime, Galva-prep, or equal; flush surface clean with water and allow to dry.
- E. Prepare all surfaces in accordance with the more stringent of the coating material manufacturer's recommendations, other requirements in this paragraph 3.02 or referenced or applicable requirements for surface preparation in the Steel Structures Painting Manual, Volume 2, published by the Steel Structures Painting Council and summarized below:
 - 1. SSPC-SP1 - Solvent Cleaning: Removal of all oil, grease, soil, drawing compound, cutting compound and other soluble contaminants from the surfaces with solvents and/or commercial cleaners by wiping, dipping, steam cleaning or vapor degreasing.
 - 2. SSPC-SP2 - Hand Tool Cleaning: Removal of all loose mill scale, rust, paint and other loose detrimental foreign matter by the use of non-powered hand tools.

3. SSPC-SP3 - Power Tool Cleaning: Removal of all loose mill scale, rust, paint and other loose detrimental foreign matter by the use of power-operated portable tools.
 4. SSPC- SP6 - Commercial Blast Cleaning: Removal of all oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter by compressed air nozzle blasting, centrifugal wheels or other required methods. Remaining discoloration stains shall not exceed 33-1/3% of each square inch of surface.
 5. SSPC-SP7 - Brush-Off Blast Cleaning: Removal of all oil, grease, dirt, dust, loose-mill scale and loose paint by compressed air nozzle blasting. Centrifugal wheels or other required means.
- F. Dust all surfaces and wipe clean with a tack rag just prior to coating.

3.03 APPLICATION

- A. Apply all material in strict accordance with manufacturer's instructions. Apply first coat immediately after surface preparation.
- B. Do not apply coatings when temperature is below 55°F. Do not apply exterior coatings in damp or rainy weather. Do not apply exterior coatings on damp wood.
- C. Brush out each coat to a uniform, even coating; lay material on in one direction and brush out at right angles. Special application techniques may be required for new coatings with low VOC content. Apply such coatings in strict accordance with manufacturer's detailed instructions. Allow material to dry 48 hours between coats unless longer period specified by manufacturer.
- D. Sand between coats for enamel finishes.
- E. Do necessary puttying or filling of nail holes, cracks and other blemishes after first coat has been applied. Finish putty or fill flush with adjoining surface in neat, workmanlike manner. Putty or fill nail holes in wood to be stained, with colored putty to match finish.
- F. Back prime all interior and exterior wood trim before installation. Prime all exposed and concealed surfaces of sheet metal flashing prior to installation.
- G. Paint items and surfaces before installation that will be difficult or impossible to paint after installation.
- H. Apply not less than the number of coats specified. Apply additional coats if required for uniform coverage and full hiding. Apply finishes in their factory original consistencies. Do not thin unless specifically recommended by the manufacturer.
- J. Finish work shall be uniform in color, full coverage, smooth and free of sags and brush marks. Varnish work shall be done so that an entire surface is coated while maintaining a wet edge so that there are no lap marks or areas of uneven color.
- K. Do all cutting in to a sharp, true line. Repaint if necessary to correct over runs.

- L. Do not paint over Underwriters' labels, fusible links, sprinkler heads, or fire alarm devices.
- M. Paint access panels, electrical panels, air registers and similar items prior to installation to prevent edges from peeling or chipping when panels are removed.
- N. Repaint factory finished electrical panels, air registers, and other items to match adjacent painted surfaces.

3.04 NOT USED

3.06 PROTECTION, CLEANING AND COMPLETION

- A. Protect finish work by suitable covering or other method as job progresses.
- B. Remove paint or varnish spots from floors, glass and other surfaces, upon completion of work. Remove rubbish, empty containers and other accumulated materials from premises. Leave work in clean, orderly, acceptable condition.
- C. Check work of this Section at completion of project. Touch-up or refinish marred or damaged surfaces. Replace glass damaged by operations under this Section. Leave entire area with finish free from imperfections.

3.07 PAINTING SCHEDULE

- A. Chemical Storage Area CMU wall: System A, as specified below.
- B. Characteristics of paint materials are described in Part 2 of this Section. First-named products are listed in the Systems in paragraph 3.08 below. Equivalent products by other manufacturers may be submitted for review in accordance with paragraphs 1.03 and 2.02 of this Section.

3.08 PAINT SYSTEMS

- A. System "A": ACRYLIC LATEX MASONRY PAINT
 - 1. Surface Preparation: Very light brush-off blasting to create a fine tooth: SSPC-SP 7.
 - 2. First Coat:
 - a. On Concrete Block: LATEX BLOCK FILLER. Devoe Coatings Interior/Exterior Heavy Duty Acrylic Block Filler, Bloxfil No. 4000.
 - 3. Second and Third Coats: FLAT ACRYLIC EXTERIOR MASONRY PAINT, applied at the rate recommended by the manufacturer. ICI Dulux Exterior Acrylic Flat Masonry Finish, Ultra-Hide Durus No. 2220.

END OF SECTION

SECTION 09960
PROTECTIVE COATINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section 09960 covers all painting and coating for the Project with the exception of the Chemical Storage Area CMU block wall which is addressed in Section 09900.
- B. Assets requiring protective coating whose colors shall be favorably reviewed prior to performing the work. Contractor and Owner or Owner's representative shall visit the existing Gloria Way Well Treatment Site, located at Gloria Way and Bay St, to review with the Owner the color selections at this existing facility to inform selection at the Pad D Standby Well. After this visit, Contractor shall provide the Owner color samples for areas being painted under this section, which Owner will evaluate and then inform Contractor of selection prior to Contractor providing submittal for favorable review.
- C. Section Includes:
 - 1. Coat or paint all facilities and equipment which are part of this Contract, except:
 - a. Metal completely embedded in concrete (except aluminum).
 - b. Piping buried in ground or encased in concrete.
 - c. Galvanized grating, galvanized bolts, and galvanized grating frames.
 - d. Chain link fence and galvanized fence gates.
 - e. Rubber.
 - f. Plastic pipe, including: polyvinyl chloride, polyethylene, and polypropylene piping, except as noted.
 - g. Stainless steel.
 - h. Bronze, brass.
 - i. Nameplates and grease fittings.
 - j. Factory finished electrical panels.
 - k. Factory fusion epoxy coated items (except for field touchup).
 - l. Aluminum or galvanized ductwork enclosed inside furred ceiling spaces.
 - m. Aluminum handrail and aluminum guardrail.
 - n. Concrete, except as defined herein, as specified elsewhere, or as shown on the Drawings.
 - o. Fiberglass.
 - p. Electrical conduit.
 - q. Copper pipe, except as defined herein, as specified elsewhere, or as shown on the Drawings.
 - r. Galvanized surfaces, except as defined herein, as specified elsewhere, or as shown on the Drawings.
- D. Related Sections:
 - 1. Section 10400: Identifying Devices

- E. The Contractor is to base this bid on using the products specified. If the products specified are 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. A reasonable difference in cost of material between the first named items specified and the products that are required to meet regulations that change after the bid date and are in effect at the time of application may be approved for payment by Change Order.

1.02 REFERENCES

- A. Where standards of surface preparation are described by citing SSPC specification numbers reference is made to the "Steel Structures Painting Manual" Volume 2 published by the Steel Structures Painting Council.
- B. American Society of Testing and Materials (ASTM):
 - 1. ASTM D4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
 - 2. ASTM D2794 Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
 - 3. ASTM D4541 Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
 - 4. ASTM F1249 Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

1.03 DEFINITIONS

- A. Dry Film Thickness (DFT) - The prime coat and the sum of all fully cured applied coats for the paint system.
- B. Exterior Surface - Surface that is not inside a building or structure and is exposed to the weather. Epoxy surfaces that are affected by the ultraviolet rays from the sun shall be considered an exterior surface if the sun can shine on the surface.
- 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.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Prior to ordering material, submit a complete schedule of materials to be used. Include manufacturer's brand name, product name, and designation number for each coat of each system to be used.

- 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. Provide the following information on each paint product:
 - 1. Abrasion resistance, ASTM D4060, 1 kg load at 1000 cycles, CS-17 wheel.
 - 2. Impact resistance, ASTM D2794, direct and reverse.
 - 3. Moisture vapor transmission, ASTM F1249.
 - 4. Adhesion, ASTM D4541.
- E. 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 to the Owner. For substituted materials, provide a list of references, including contact person and phone number, where proposed substitute paint system has been used in similar exposures. Provide a minimum of five references (no duplicate owners or agencies).
- F. Provide Material Safety Data Sheets (MSDSs) for all products.
- G. 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.
- H. Submit a full range of the manufacturer's standard and let down finish colors for review and selection by the Engineer. After final colors have been selected, submit two 8-1/2- x 11-inch samples on cardboard of each color indexed as to manufacturer and color designation. Color chips 3/4-inch x 1-1/2-inch may be used for pipe color codes. Colors may require special blending to meet Owner's requirements to match existing color systems.
- I. Submit four pipe and equipment color code charts, 11 x 14 inches in size, with typed labels and using color chips. Upon favorable review, frame charts and mount under glass, suitable for hanging in work areas.

1.05 QUALITY ASSURANCE

- A. Environmental Regulatory Requirements:
 - 1. All work, material, procedures, and practices under this Section shall conform with 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. Products specified herein are, to the best of the Design Engineer's knowledge, in compliance with the applicable volatile organic compounds (VOC)¹ 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

¹ Measured in grams per liter by weight of coating as applied, excluding water and color added to be base tint.

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, he will be responsible for any fines, costs, remedies or legal actions that may result.

1.06 WARNINGS

- A. Be advised that application of paint, epoxy and protective coating materials may be hazardous. Take all necessary precautions to ensure the safety of workers and property.
- B. 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 Owner. In addition, abrasive blasting and painting is called for in, on or around mechanical equipment, which may be damaged by grit, dust, or painting overspray. Mask, wrap, enclose and provide all protection required to safeguard this equipment at no additional cost to the Owner.
- C. Perform abrasive blasting activities in a manner that will not cause a nuisance to adjacent public and private property and equipment.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver all coating materials in unopened containers with 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. Store solvents in closed approved storage containers.
- C. Submerge solvent soaked rags in water.

1.08 PROJECT CONDITIONS

- A. Environmental Requirements:
 1. Provide ambient temperatures recommended by manufacturer of material to be applied.
 2. Provide adequate ventilation.
 3. Provide 40- to 50-foot candles of illumination on all surfaces in areas to be painted including floors, walls and ceiling even though they do not require painting.
 4. Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

1.09 COLORS AND SAMPLES

- A. Before starting work, obtain favorably reviewed color schedule.
- B. 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.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Paints used in each system to be the product of one manufacturer.
- B. Shop applied prime coats shall be compatible with the systems included in these specifications.
 - 1. Final coat on exterior surfaces of equipment and piping shall be field applied using a product from one manufacturer. Contractor is responsible for ensuring that final coat is compatible with all systems used.
- C. Substituted coating systems shall be of the same generic type as those specified.
- D. Coating systems shall not contain lead.
- 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 refer to the following manufacturers and are specified as levels of quality. It is understood that the words "or equal" are included herein

Abbreviations:

- Carboline (CAR)
- Sherwin Williams (SW)
- Kop Coat (K)
- Tnemec Co. (T)
- Roto Metals (RG)
- Protecto Wrap (PW)
- Tapecoat (TC)
- Chemical Products Co. (ZRC)
- Ameron (A)
- Thermecoat-Welco (TW)
- CRC Industries (CRC)

2.02 PAINT SYSTEMS

System 1: General Ferrous Exposed to Atmosphere

1st Coat - bare metal	High Solids Epoxy	(T) Series 135 (CAR) Carboguard 890
Finish Coat(s) Total DFT = 12 mils	High Solids Epoxy	(T) Series V69 (CAR) Carboguard 890
Final coat for exterior surfaces DFT = 2 mils additional	Aliphatic Polyurethane	(T) Series 74 (CAR) Carbothane 134VOC

System 3A: Potable Submerged Ferrous Metal (Well Discharge Riser Pipe)

Two coats DFT = 16-18 mils	Factory NSF Lined and Coated	(T) Series 22, (CAR) Plasite 4500. Or equivalent
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If touchup is required, including touchup around the couplings after pipe assembly, (T) Series FC 22 or equivalent.

System 3B: Potable Submerged Ferrous Metal (Other Items)

Three coats DFT 12-18	NSF High Solids Epoxy	(T) Series V140, Pota-Pox Or Series V140F (A) Amerlock 400/2 Or equivalent
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System 6: Galvanized Steel and Non-Ferrous Metals

1st Coat(s)	High Solids Epoxy	(A) Amerlock 400 (T) Series 135
2nd Coat DFT = 8 mils	High Solids Epoxy	(A) Amerlock 400 (T) Series 69
Finish coat – exterior surfaces DFT = 2 mils additional	Aliphatic Polyurethane	(A) Amercoat 450HS (T) Series 74

System 7: Miscellaneous Service Coating

One full brush coat	Coal Tar	(K) Bituplastic #33 (T) 46-40 Tnemecol
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System 8: Buried Valves

One full brush coat DFT = 20 - 30 mils		(PW) 160/160 H Mastic (TC) TC Masti
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System 11: Exterior Non-Insulated PVC Pipe

First Coat	Primer	(ICI) "Gripper"
Second and Third Coat	Exterior Semi Gloss Enamel	(ICI) Devflex 4206
or 2 Coats	Waterborne Acrylic (Semi Gloss)	(T) Series 1029

System 12: Hydropneumatic Tank

Interior:

First Coat DFT = 8 mils	High solids polyamine- epoxy	(C) Carboguard 891 VOC (T) Series 22
Second Coat DFT = 8 mils	High solids polyamine- epoxy	(C) Carboguard 891 VOC (T) Series 22
Finish Coat DFT = 8 mils	High solids polyamine- epoxy	(C) Carboguard 891 VOC (T) Series 22

Exterior:

First Coat DFT = 5 mils	Zinc rich epoxy	(C) Carboguard 859 VOC Or equal
Second Coat DFT = 8 mils	High solids polyamine- epoxy	(C) Carboguard 891 VOC (T) Series 22
Finish Coat DFT 5 mils	Aromatic Polyurethane Hybrid	(C) Reactamine 760 Or equal

System 13: Chemical Storage Area

First Coat	100-125 mils DFT of Enduraflex-1988, Carboline Semstone 140 AFC, or approved equal.
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PART 3 - EXECUTION

3.01 SURFACE PREPARATION

- A. Perform surface preparation in accordance with Paragraph 3.02 below and the latest revision of the following requirements or manufacturer's requirements, whichever is more stringent:
1. Shop Prime: Shop prime all steel surfaces not subject to abrasive blasting. Clean surfaces in accordance with the Structural Steel Painting Council specifications SSPC-SP 2, "Hand Tool Cleaning," and SSPC-SP 3, "Power Tool Cleaning."

2. Brush Clean: Remove dirt, dust, loose rust and foreign matter in accordance with specification SSPC-SP 2, "Hand Tool Cleaning."
3. Solvent Clean: Solvent clean metallic surfaces to be painted to remove all oils or grease in accordance with specification SSPC-SP 1, "Solvent Cleaning." Use solvents recommended by manufacturer of paint to be used in each area. In addition, lightly hand sand copper piping.
4. Abrasive Blast: Conform to the requirements of SSPC-SP 10, "Near White Blast Cleaning." Paint all blasted surfaces within 8 hours of blasting unless the Engineer gives specific permission to do otherwise. Remove all weld spatter by grinding or chipping prior to sandblasting.
5. Commercial Blast Cleaning: Conform to the requirements of SSPC-SP 6 Paint all blasted surfaces within 8 hours of blasting unless the Engineer gives specific permission to do otherwise. Remove all weld spatter by grinding or chipping prior to cleaning.
6. Hydropneumatic Tank – Internal Surface Preparation: performed in accordance with an SSPC-SP 10 Near White Metal Blast Cleaning. When viewed without magnification shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter of at least 95% of each unit area. Staining shall be limited to no more than 5 percent of each unit area, and may consist of light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coatings. Unit area shall be approximately 3 in. x 3 in. (9 sq. in.).
7. Hydropneumatic Tank – External Surface Preparation: SSPC-SP6 / NACE 3 Commercial Blast Cleaning will be used. When viewed without magnification, the surface shall be free of all visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter of at least 66-2/3% of unit area, which shall be a square 3 in. x 3 in. (9 sq. in.). Light shadows, slight streaks, or minor discolorations caused by stains of rust, stains of mill scale, or stains of previously applied coating in less than 33-1/3% of the unit area is acceptable.

3.02 APPLICATION

- A. All steel coating application to be done in accordance with the latest revision of SSPC-PA: When successive coats of paint of the same colors are specified, tint alternate coats sufficiently to produce enough contrast to indicate complete coverage of the surface.
- B. Apply all material in strict accordance with manufacturer's instructions. 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 Engineer in conformance to individual paint manufacturer's recommendations. The Engineer and paint supplier 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 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 and remove all runs, sags, overspray, surface roughness and other defects between each coat. Dust and wipe surface clean before applying next coat.
5. Cutting in is to be sharp and straight, free from overlaps or fuzzy edges. Redo any imperfect work.
6. Apply not less than the number of coats or dry film thickness specified. Apply additional coats if required for uniform coverage, full hiding, and to achieve film continuity. Finished work to be uniform in color, full coverage, smooth and free of sags and brush marks.
7. Do not apply coating when temperature is below 55°F or when the temperature of the surface to be painted is less than 4°F over the dew point temperature. Perform coating operations only under favorable environmental conditions. Take all steps necessary to protect and completely cure the work. Correct defective work to the full satisfaction of the Engineer.
8. Apply the last finish coat on all work after all major construction is complete and the work areas have been cleaned up and are dust free.

3.03 PIPE AND EQUIPMENT IDENTIFICATION

- A. Identify all piping and equipment exposed to the atmosphere, both interior and exterior, and including pipe located in concrete pipe trenches, by a combination of color coding, stenciling or pressure-sensitive tape and direction arrows.
- B. Identify painted pipe 4 inches in diameter and larger by stenciling identification names and directional arrows. Identify unpainted pipe and pipe less than 4 inches in diameter with labels and arrows as described in Section 10400. Place names and arrows every 16 feet and wherever a pipe enters or leaves a room or a pipe trench. Provide lettering size as follows:

<u>Pipe Diameter</u>	<u>Lettering Size (Height)</u>
1-1/4" or less	1/2"
1-1/2" to 2"	3/4"
2-1/2" to 6"	1-1/4"
8" to 10"	2-1/2"
Over 10"	3-1/2"

- C. Provide pipe identification names as listed in the table below. Directional arrows are to be in black and be proportional to lettering. Color of equipment and pipe shall be as shown on a schedule to be provided by the Engineer. Gloss enamel is to be used for stenciling.

Abbreviation	Service
AS	Ammonium Sulfate
CL	Calcium Hypochlorite
D	Drain
GW	Groundwater
GWBO	Groundwater Blowoff
SA	Sample
TW	Treated Water

- D. The Engineer will prepare a color schedule after the protective coatings are favorably reviewed. Notify the Engineer 30 days before the color schedule is needed. Colors will require special mixing. The number of different colors needed will be as indicated by the following schedule.

- Process - Each in a different color
- Air - Digester/Sludge Gas and Foul Air to have one color and Airwash Air to each have a another color. Remainder to have another color.
- Potable Water - One color
- Non-Potable Water - Once color
- Drainage - Sample Drain and Instrument area drain one color. All others another color

E. Paint equipment in the same color as the pipe to which it is connected.

F. Paint conduit and ductwork in colors to match adjacent walls/ceilings.

3.04 FIELD QUALITY CONTROL

A. Pinhole and Continuity Testing:

1. After the application of the prime and finish coats of Paint Systems 3 and 9 surface protective coating systems on metal surfaces, 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.

2. The Engineer or an 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. THE CONTRACTOR'S ATTENTION IS DIRECTED TO THE FACT THAT PAST USE OF THIS INSTRUMENT HAS DEMONSTRATED THAT THE PAINTER MUST APPLY AT LEAST TWO AND USUALLY THREE OR MORE STRIPE COATS ALONG ALL EDGES AND ANGLES AND CREVICES FORMED BY JOINING MEMBERS 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" is to be used by the Contractor to accomplish this demonstration.
- 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.

3.05 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.

3.06 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.

3.07 APPLICATION SCHEDULE

- A. Provide coatings in accordance with the following exposure schedule:

<u>Exposure</u>	<u>Surface Preparation</u>	<u>Paint System</u>	<u>Note (see below)</u>
General ferrous exposed to atmosphere	Bare Metal: Sandblast Shop Primed: Hand Tool Cleaned	1	1
Submerged ferrous metal	Abrasive Blast except Solvent Clean galvanized items	3A, 3B	3
Exposed galvanized steel, copper and other non- ferrous metals	Solvent clean, lightly Hand Sand	6	6
Vent pipes exposed at building roofs and metal mounted in contact with walls	Hand Tool Cleaning	7	7
Buried valves, flanges, etc.	Solvent Clean and Hand Tool Cleaning	8	8
Factory finish coated items not requiring field painting	Touchup	-	9
Exposed PVC Pipe	Solvent Clean, Light Scour	11	12
Hydropneumatic Tank	See Section 3.01, paragraph 6 and 7	12	N/A
Chemical Storage Area	In accordance with manufacturer recommendations	13	13

Notes to Application Schedule

1. These surfaces include, but are not limited to: general miscellaneous ferrous metal; machinery; pumps; blowers; compressors; supports; valve handwheels and stands; valve bodies; piping systems; structural steel; steel elements; except where other systems in this schedule are more specifically applicable.
2. Use galvanize-repair paint to repair-galvanize surfaces to be painted. Use eutectic-type repair to repair-galvanize surfaces to remain unpainted.
3. Apply this system to ferrous metal submerged in or suspended over water or sludge. These surfaces include, but are not limited to, machinery parts, piping, valves, brackets and supports, and miscellaneous supports, braces, and pump columns. Coat inaccessible surfaces prior to erection.
4. NOT USED.
5. NOT USED.

6. Exposed galvanized ducts, exposed metal electric conduit, other galvanized steel items except those specifically excluded, exposed copper pipe and other non-ferrous metal items.
7. All cast iron soil pipe and associated flashing above the building roof. Also coat metal items, which are surface, mounted on exterior, basement or gallery masonry walls, plaster walls and concrete surfaces. Coat such metal items only on the contact surfaces unless otherwise specified; specifically include electrical panels, control cabinets, fixtures and guardrail support brackets.
8. Buried steel and cast-iron valves, operators, steel flanges, and other buried ferrous metals.
9. All panels and equipment with factory finishes identified elsewhere as not requiring field paint, damaged during shipping, storage, or installation: touch-up in the field in a manner compatible with the factory coating with respect to paint type, color, and texture. Touch-up fusion epoxy-coated items only with material provided by the fusion epoxy fabricator. If more than 5% of the surface requires touchup, return the items to the fabricator for recoating.
10. NOT USED
11. NOT USED
12. Clean pipe thoroughly with solvent and lightly scour before applying coating.
13. Coat the concrete floor, sump, and the internal CMU walls five feet for the floor in the two chemical cells in the chemical storage area.

END OF SECTION

SECTION 10400
IDENTIFYING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Signs, decals, tags, and pipe markers.
- B. Related Sections:
 - 1. Section 09960: Protective Coatings - pipe markers

1.02 REFERENCES

- A. American National Standard Specifications, ANSI A13.1, "Scheme for the Identification of Piping Systems."
- B. National Fire Protection Association (NFPA) No. 704, System for the identification of the fire hazards of materials.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data: Fully describe all items proposed for use.
- C. Shop Drawings: Scaled drawings or photostats of custom-made signs, showing style and size of lettering and colors.
- D. Samples: Manufacturer's standard color palette for selection.

1.04 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the following:
 - 1. Americans with Disabilities Act (ADA).
 - 2. Federal Occupational Safety and Health Act (OSHA): Referenced sections, specifications for accident prevention signs and tags and exit signs.
 - 3. Porcelain Enamel Institute Sign Division of the PEI:S-103, recommended standards for porcelain enamel signs.
- B. Comply with the manufacturer's published recommendation for installation of materials used.

PART 2 - PRODUCTS

2.01 SIGNS

- A. Caution Signs:
 - 1. Size: 14 inches wide by 10 inches high

2. Material: Porcelain Enamel, 18-gauge. Text,
format, and color:
 - a. Conforming to OSHA 1910.145(d)(4), Specifications for Caution Signs.
 - b. Text as scheduled below.
 - c. Include international pictogram
4. Provide eyelet holes at each corner for mounting.
5. Schedule of signs required:

Quantity	Text
2	CAUTION THIS EQUIPMENT STARTS AUTOMATICALLY
1	CAUTION WEAR EYE PROTECTION, RUBBER GLOVES AND APRONS WHEN HANDLING CHEMICALS
3	CAUTION (heading only, no printed message)

B. Danger Signs:

1. Size: 14 inches wide by 10 inches high, unless otherwise scheduled.
2. Material: Porcelain Enamel, 18-gauge.
3. Text, format, and color:
 - a. Conforming to OSHA 1910.145(d)(2), Specifications for Danger Signs.
 - b. Text as scheduled below.
 - c. Include international pictogram
4. Provide eyelet holes at each corner for mounting.
5. Schedule of signs required:

Quantity	Text
1	DANGER DO NOT DRINK WATER (Size: 10"w x 7"h)
2	DANGER (danger heading only, NO printed message)

C. Informational Signs:

1. Size: 14 inches wide by 10 inches high.
2. Material: Semi-rigid plastic with adhesive back.
3. Text, format, and color:
 - a. Conforming to OSHA 1910.145 (d)(9), Specifications for Informational Signs.
 - b. Text as scheduled below.
4. Provide eyelet holes at each corner for mounting.
5. Schedule of signs required:

Quantity	Text
1	NOTICE AUTHORIZED PERSONNEL ONLY
3	NOTICE NO TRESPASSING

D. NFPA Fire Hazards of Materials Signs:

1. Seton Nameplate Company; W.H. Brady Company; or equal.
2. Sign characteristics: 4-color background, blue, red, yellow, white; diamond shape; 7-1/2 inches by 7-1/2 inches; 3-inch-high black hazard numerals scheduled below; conform to NFPA No. 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
3. Material: Semi-rigid plastic with adhesive back.
4. Where mounted to concrete or other porous materials provide 3/4-inch-thick AB Marine grade Douglas Fir plywood backing, sealed edges, painted. Eyelet holes at corners for mounting.
5. Schedule of signs required:

Quantity	Hazardous Material	Blue (Health)	Red (Fire)	Yellow (Reactivity)	White (Specific Hazard)
1	Ammonium Sulfate	1	0	1	--
2	NFPA Hazard Information Sign 14"w x 10"h				

E. Chemical Signs:

1. Seton Nameplate Company; Style SCS; Legi-Sign; or equal.
2. Size: 10 inches wide by 14 inches high.
3. Material: Semi-rigid plastic with adhesive back.
4. Characteristics: Red text on white background. Text shall include chemical name, precautionary measures, signal word, statement of hazards, and antidote. Sign shall include NFPA No. 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
5. Where mounted to concrete or other porous materials, provide 3/4-inch-thick AB marine grade plywood backing, sealed edges, painted. Eyelet holes at corners for mounting.
6. Schedule of signs required:

Quantity	Chemical Name
1	Calcium Hypochlorite
1	Ammonium Sulfate

F. Equipment and Process Identification Signs

1. Custom engraved plastic signs shall be provided for equipment and process identification. Signs shall consist of engraved white characters on a medium blue, red, or black background. Specific colors shall be selected by the City Representative from color samples submitted by the Contractor. Plastic shall be suitable for exterior use and shall be a minimum of 1/8-inch thick. All sign edges shall be beveled.

2.02 TAGS

A. Accident Prevention Tags:

1. Seton Nameplate Company; W.H. Brady Company; or equal.
2. Size: Approximately 3 inches by 6 inches.
3. Material: Write-on matte finish plastic laminate, metal reinforced eyelet. Provide nylon or wire-tie fasteners.
4. Conform to OSHA 1910.145(F), Specifications for Accident Prevention Tags.
5. Text as scheduled below:

Quantity	Text
3	DANGER - DO NOT DRINK WATER
3	DANGER - DO NOT START
3	DANGER - DO NOT OPEN
3	DANGER - DO NOT CLOSE
3	DANGER - HIGH PRESSURE GAS
3	EMPTY (red colored tag)
3	FULL (green colored tag)
3	CAUTION - IN USE (yellow colored tag)
3	DANGER - DO NOT OPERATE
5	OUT OF ORDER

B. Valve Tags:

1. All new valves, regardless of size and location (interior, exterior, vaults, etc.) shall be provided with a valve tag. Valve tags shall be manufactured from Type 304 stainless steel sheet, 16 gauge, and shall be rectangular shaped with a ¼-inch hole for stainless steel mounting chain. Size shall be as required into fit all text and border. All edges shall be ground to produce round edges without burrs.
2. Valve tags shall be permanently stamped with 3/16-inch high characters to record the following information: valve number (if any, service abbreviation and number), nominal size (inches), manufacturer name, and model number.

2.03 PIPE MARKERS

- A. Seton Nameplate Company; SetMark, W.H. Brady Company; Piper Marker System 1; or equal.
- B. Pipe Markers conforming to ANSI A13.1. See paragraph 3.03 for required locations.
- C. Material: Acrylic plastic snap-around type, temperature tolerance range of -40°F to 250°F, non-fade, colored fields, lengths as shown below.
- D. Text: Non-fade ink, lettering size, as shown below:

Outside Diameter of Pipe (Inches)	Length of Color Field (Inches)	Size of Letters (Inches)
3/4 to 1-1/4	8	1/2

1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	36	3-1/2

E. Provide directional arrows to indicate flow direction. See paragraph 3.03.

F. Pipe Marker Schedule

1. The colors below are not final. Verify colors with Owner. Colors will be modified to be consistent with painted pipe color coding. The colors will be selected from manufacturer's standard.

2. LETTERING AND COLOR TABLE

Text	Field Color	Letter Color
Ammonium Sulfate	Yellow	Black
Calcium Hypochlorite	Yellow	Black
Bypass	Yellow	Black
Drain	Green	Black
Groundwater	Yellow	Black
Groundwater/Blowoff	Yellow	Black
Hot/Tepid Water	Yellow	Black
Non-Potable Water	Green	Black
Sample	Yellow	Black
Sample Drain	Yellow	Black
Treated Water	Yellow	Black

PART 3 - EXECUTION

3.01 SIGN INSTALLATION

- A. Install signs where directed by the Engineer.
- B. Install signs after painting surfaces to receive signs. Follow manufacturer's written installation instructions.
- C. Use fasteners as follows:
 - 1. To concrete and masonry materials: 4-1/4-inches diameter expansion anchors.
 - 2. To sheet metal (gauges 28 to 6) #10 sheet metal screws.
 - 3. To gypsum board: Adhesive backing tape.
 - 4. To chain link fencing: Wire ties at each corner.
 - 5. To plywood backing boards: #10 wood screws.
 - 6. To machinery: Fasteners as suitable.
- D. Set sign posts in concrete.

3.02 TAGS

- A. Do Not Drink Water Tags: Tie to faucets of non-potable water hose bibs as directed by Engineer.
- B. All Other Tags: Deliver to the Owner in properly identified boxes or envelopes.

3.03 PIPE MARKERS

- A. Pipe Markers shall be applied where piping enters or leaves the wall or floor of a structure, adjacent to tanks or other hydraulic containments, at each valve, at each piping change in direction, and shall be applied along piping runs not exceeding 16 feet on center.
- B. Directional Arrows: Point in the direction of flow.
- C. Locate pipe markers for easy reading. Where pipes are located above normal line of vision, the lettering and directional arrows shall be placed below the horizontal centerline of the pipe. Where pipes are below normal line of vision, lettering and directional arrows shall be above the horizontal centerline of the pipe.

END OF SECTION

SECTION 11210

DEEP WELL SUBMERSIBLE PUMPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Submersible turbine type pump assembly with electric submersible motor, power cable, inlet strainer, suction casing, pump bowls, discharge column, well plate, discharge head and pump appurtenances as shown on the Drawings and specified herein.

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. A48, Gray Iron Castings
2. A276, Stainless Steel Bars and Shapes
3. A320, Alloy Steel Bolting Materials for Low Temperature Service Ductile Iron Castings
4. A582, Free-Machining Stainless Steel Bars
5. B584, Copper Alloy Sand Castings for General Applications

1.03 PERFORMANCE REQUIREMENTS

A. The required pump characteristics shall be as follows:

Tag Numbers	20-P-100
Pump Name	Well Pump
Design Point 1 (Low Groundwater)	500 gpm @ 335 ft TDH ± 10 ft
Design Point 2 (High Groundwater)	500 gpm @ 315 ft TDH ± 10 ft
Speed	3500 rpm
Maximum Motor Horsepower	60 hp
Minimum Pump Efficiency	
@ Design Operating Point	80 Percent
Shut Off Head, @ 0 GPM	400 ft ± 10 ft
Motor Data (speed/phase/volts)	3500/3/480

1.04 SUBMITTALS

- A. Shop Drawings and Product Data: Submit the following as a single complete initial submittal in accordance with Section 01300 and include the following:
 - 1. Note used
 - 2. Pump name, identification number and specification number.
 - 3. Product data fully describing all items proposed for use to demonstrate that the equipment conforms to the Specifications.
 - 3. Motor data as specified in Electrical Specifications or herein..
 - 4. Pump layouts and dimensions.
 - 5. Pump performance curves.
 - 6. Materials of construction.
 - 7. Certification with related drawings that well plate anchors are designed per requirements to be established by Contractor Design Engineer..
- B. Performance Testing: Certified non-witnessed factory performance tests in accordance with Hydraulics Institute Standards are required for each pump. Obtain favorable review from the Engineer prior to shipment of the pumps.
- C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and parts lists.
- D. Affidavits: Furnish affidavits from the manufacturer stating that the equipment has been properly installed, adjusted and tested and is ready for full time operation.

1.05 QUALITY ASSURANCE

- A. All equipment furnished under this Section shall: (1) be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years; and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.
- B. All pumps furnished under this Specification Section shall be of a single pump manufacturer.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Deep well submersible pump shall be Grundfos 475S-6; Goulds; or equal, modified to provide the specified features and to meet the specified operating conditions.

2.02 MATERIALS

A. Materials of construction shall be as follows:

<u>Component</u>	<u>Material</u>
1. Suction inlet, bowl assembly and discharge adapter	ASTM A276 or A582, Stainless Steel
2. Bowl wear rigs	ASTM B584, Bronze, or ASTM A48, Cast Iron
3. Pump shaft	ASTM A276 or A582, Type 416 Stainless Steel
4. Impeller	Cast stainless steel (all stages)
5. Impeller lock Collets	ASTM A276, Stainless Steel
6. Pump bearings	ASTM B584, Bronze
7. Pump discharge column	ASTM, Stainless Steel
8. Motor adapter	ASTM, Stainless Steel
9. Motor coupling	ASTM A582, Stainless steel, Type 416
10. Discharge elbow	ASTM, Fabricated Stainless Steel
11. Strainer	ASTM A320, Stainless Steel, Type 304
12. Bolts, studs, and nuts	ASTM A320, Stainless Steel, Type 304

2.03 EQUIPMENT FEATURES

- A. Motor Adapter: The bottom of the pump shall be fitted with a one piece casting motor adapter designed to serve as the suction inlet, lower bearing housing and motor adapter piece. The coupling housing portion shall be designed to prevent the entrance of abrasive material into the top end of the motor. The coupling connecting the motor to the pump bowl assembly shall be of sufficient size and strength to withstand maximum torque generated by the motor.
- B. Strainer: The suction inlet shall be provided with a strainer having a net inlet opening area of not less than four times the impeller inlet area. The strainer or mesh openings shall be sized to prevent passage of particles larger than the solids handling capability of the impeller.
- C. Suction Inlet: The suction case shall be designed to provide conservative entrance velocities and evenly distribute the flow to the impeller. The inner surface of the case shall be smooth and free from projections or cavities. The pump shaft lower bearing shall be housed in a streamlined casing, centered and held in place by means of rigid cast vanes.
- D. Pump Bowl: The pump bowl shall be flanged for registered fit. Flow passages through the bowl shall be porcelain enamel-lined. The first-stage bowl shall be designed to facilitate a low NPSH impeller arrangement and first stage impellers shall be cast stainless steel. All pump bowls shall be designed to handle the shutoff head of the pump. Bowls shall not be designed to different pressure depending on stage.

Bowl assembly shall be equipped with wear rings. One bowl wear ring shall be installed for each bowl in the bowl assembly. Bowl wear rings shall be installed on the suction side of the bowl seat.

- E. Impeller: The impeller shall be constructed free from projections, cavities, or abrupt transitions. The impeller surfaces shall be either polished or porcelain-lined.

Impellers shall be of the enclosed type, with the shroud designed to rotate against wearing rings installed in the bowl assembly. Impellers shall be secured to the pump shaft using tapered collets or keyways.

- F. Shafts: Shafts shall be sized to prevent excessive elongation and transmit the required torque without distortion in both the forward and reverse direction. Shafts shall have a first critical speed not less than 20 percent above maximum operating speed. The pumping units shall utilize a single pump shaft extending from the suction case through a discharge case or upper bowl case containing an upper pump shaft bearing.

- G. Bearings: Suction case, bowl, and lower tube bearings shall be close tolerance, sleeve type. Bearings shall be lubricated by the process fluid or grease lubricated. The top case of the bowl assembly shall contain an extra long sleeve bearing with a sand cap. Intermediate bearings shall be furnished at each bowl assembly. The bearings shall have a minimum B-10 life expectancy of 100,000 hours for continuous service.

- H. Motor: The motor shall be of the submersible electric motor type, capable of continuous operation at nameplate rating under water at a maximum temperature of 95 degrees F and suitable for across the line starting. Motor shall be a nominal 3,450-rpm unit. The maximum horsepower rating of the motor shall be as specified in Section 11210 - 1.03A, and the motor shall have a minimum Service Factor of 1.15. The motor nameplate full load rating shall not be exceeded at any point on the pump performance curve.

The motor's full load efficiency rating shall not be less than the amount specified in Section 11210 - 1.03A with a minimum power factor of 87 percent. The full load efficiency shall include 100 percent of the thrust bearing's rated loading. For purposes of flow, the maximum motor diameter at the stator case shall not exceed 10 inches.

The motor shall be water filled "wet winding type". It shall be filled with a 50/50 solution of water and food grade propylene-glycol. Motor shall be designed to be properly cooled by passage of water past the motor.

Motor materials of construction shall be stainless steel, or stainless steel fitted. All wetted fasteners and washers shall be of Type 316 stainless steel. Mating threaded components shall be of non-galling alloys.

The motor shall be totally enclosed, utilizing an elastomer expansion diaphragm for the equalization of internal and external pressure.

The motor shall be equipped with a double rubber type shaft seal to seal the motor at the point that the shaft extends through the casing.

Replaceable carbon composite material sleeve type radial bearings shall be provided at each end of the motor.

Thrust bearings shall have capacity to carry the weight of all rotating parts plus the hydraulic thrust at shutoff head. This shall be an integral part of the driver. The pivotal shoes shall be stainless steel and the thrust driver (or thrust bearing) shall be of stainless steel material. Antifriction bearings shall be designed such that the L_{10} calculated life shall be no less than 8,800 hours. Thrust bearings shall also be able to support down thrust conditions for a minimum of five minutes with the discharge valve closed.

The motor leads shall be sealed at the motor top bracket.

The multiconductor cable shall be stranded copper conductors, and meet ASTM class B. Insulation shall be ethylene propylene rubber (EPR) type suitable for continuous immersion in water. Cable shall be non-hygroscopic with an overall neoprene jacket and classified for RHW service. The cable shall have sufficient area to meet ICEA requirements for operation in air. Cable shall be mechanically shielded where it passes the pump bowls. Sufficient cable shall be provided to reach from the motor to the wellhead splice box. The length of cable shall include adequate length to account for sagging of the cable, or wrapping around the column pipe. The cable shall be supported on the column pipe with stainless steel straps every 8 feet.

A flow inducer collar shall be provided to ensure a cooling flow past the motor.

2.04 COLUMN CHECK VALVE

- A. The pump column shall be equipped with a column check valve, located immediately above the pump assembly. Check valves shall be stainless steel body, slow bleed back, double door type. Check valves shall be nominal size as column pipe, threaded to match the column pipe. Valves will meet all strength requirements for the column pipe.

2.05 DATA PLATES

- A. Mount a data plate on each pump unit. Data plates shall contain the manufacturer'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 that contains identification of frame and bearing numbers.

2.06 PAINTING

- A. Do not paint stainless steel components.
- B. Provide pumps, motors and bases with the manufacturer's standard factory applied paint finish. The columns, suction inlets, inlet bells, and pump bowls shall be lined and coated with factory applied 8-mil coat of paint as specified below.
 - 1. Manufacturer: Tnemec P66 Epoxoline; Koppers High Guard Epoxy; or equal. Epoxy coating shall be food grade and suitable for use with potable water. Factory test the coating and lining for thickness and holidays.
 - 2. Protect the lining and coating against transportation damage. The lining and coating shall be subject to retesting and inspection at the job site, and deficiencies will be corrected by the Contractor in the field to the satisfaction of the Engineer.

2.07 WELL BASE PLATE

- A. Pump supplier shall design a steel well plate and discharge elbow and anchors to accommodate the well pump weight, riser pipe weight (based on galvanized steel pipe), and any pump up or down thrust. As part of this scope, Contractor shall install a neoprene gasket between the well plate and pump discharge head.

2.08 SPECIAL TOOLS

- A. Furnish a full set of manufacturer's special tools that are necessary for the replacement of parts and the adjustment of the equipment.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install equipment in strict conformance with manufacturer's installation instructions. Check pump and motor alignment according to the Standards of the Hydraulics Institute after pump and motor have been installed.

3.02 FIELD SERVICE

- A. The manufacturer shall provide a competent field service Engineer to thoroughly check and inspect the pumps after installation, place the pumps in operation and make necessary adjustments, and instruct plant personnel in proper operating and maintenance procedures.

3.03 FIELD PAINTING

- A. Pumps, motors and appurtenances shall receive touchup service in the field as required in accordance with Section 09960.

3.04 FIELD TESTING

- A. Perform field testing, observed by the Engineer, to demonstrate that the installed pump equipment provides the hydraulic performance determined by factory tests and that the equipment runs smoothly and is free from excessive noise and vibrations. Hydraulic Institute vibration limits shall govern.

3.05 PRESSURE GAUGES

- A. All pump installations shall be provided with pressure taps and gauge cocks on the discharge side of the pump. Where such taps are not provided on the pump body itself, they shall be provided on the piping immediately downstream of the pump.

3.06 FINAL ACCEPTANCE AND WARRANTY

- A. Final acceptance of all equipment furnished under these Specifications will be withheld until after the installation and satisfactory field testing. The manufacturer and the Contractor shall warranty the equipment against defects of any kind for a period of two years after Substantial Completion.

END OF SECTION

SECTION 11350

SAMPLE PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide Sealless Magnetic-Drive Centrifugal Sample pump and accessories, including control panels as identified in the pump schedule.

1.2 SUBMITTALS

- A. Shop Drawings:
 - 1. Submit all items under this paragraph as part of a single Shop Drawing review package.
 - 2. Submit shop drawings in Product Review. Include sufficient data to show that equipment conforms to Specification requirements, including a prototype pump curve. Include sufficient data to show that equipment will fit into the available space.
- B. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts list.
- C. Affidavits: Furnish affidavits from the manufacturer or supplier stating that the pumps have been properly installed and tested, and each is ready for full time operation.

1.3 QUALITY ASSURANCE

- A. All equipment furnished under this Section shall be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years. Demonstrate to the satisfaction of the Engineer that the quality is equal to equipment made by the manufacturers named herein.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Furnish magnetic-drive, centrifugal pumps, close-coupled to an electric motor with mounting base. Units shall be specially designed for indoor or outdoor use as specified herein.
- B. Install pumps in each of the locations noted on the Contract Drawings and sized according to the schedule below:

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Pump Schedule:

Item	<i>Free Chlorine Sample Pump (20-P-810) and Chloramine Sample Pump (20-P-840)</i>
Quantity of Pumps	2 (One for free chlorine and one for chloramine)
Mounting Location	Outdoor, under Instrument Area Pre-Engineered Canopy
Temperature Range (deg F)	30 degrees to 100 degrees
Primary Point	2 gpm @ 30 ft. TDH
Maximum Capacity	3.5 ± 1 gpm @ 1 ft. TDH
Shutoff Head	38 ± 2 ft. TDH
Motor Speed, nominal	3450 RPM
Motor Horsepower	1/12 HP
Manufacturer/Model ²	March 320-CP-MD, Iwaki America MD-30RZ
Motor Type	TEFC, moisture-protected
Suction/Discharge Connections ³	½-inch MNPT x 3/8-inch MNPT
Power Supply	120-volt, 1-phase, 60 Hz
Control Panel	Local control panel

B. Pumps shall operate without excessive noise or vibration over the full operating range indicated in the pump schedule. Vibration shall meet Hydraulic Institute standards.

C. Actual tested horsepower of each pump shall not exceed motor nameplate horsepower at any point on the pump curve.

D. Pumping Unit Design:

1. Each pump shall be a seal-less, magnetic-drive centrifugal pump, designed for continuous duty under flooded suction.
2. Materials of Construction:
 - a. Pump Casing and End Cover: Glass-filled polypropylene
 - b. Impeller: Glass-filled Polypropylene
 - c. Impeller Shaft (Spindle): Ceramic
 - d. Thrust Ring (Washer): Ceramic
 - e. O-ring: Viton
3. Provide threaded suction and discharge connections as indicated in the Pump Schedule.
4. Magnetic Drive: A dynamically-balanced, encapsulated, drive magnet shall generate a rotating field from the electric power supply. The magnetic field shall cause rotation of the pump impeller without direct contact to the electric motor shaft.

5. Electric Motor: Per manufacturer's standard offering for the designated indoor/outdoor location and temperature range.
6. Each unit shall be provided with a minimum 10-foot length, 3-conductor cable, designed for connection to a grounded 120V, single-phase power circuit.
7. Shop Painting: Pumps, motors, and accessories shall receive the manufacturer's standard finish.
8. Tools: The pumps shall be furnished with a full set of special tools and maintenance instructions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Equipment shall be installed in strict conformance with the manufacturer's installation instructions.

3.2 FIELD TESTING

- A. The pumps shall be tested to verify that they are operating properly and are able to pump the design flow rate.

END OF SECTION

SECTION 11400

PACKAGE HYPOCHLORITE CHEMICAL FEED EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Packaged Calcium Hypochlorite Tablet-based Chemical Feed Equipment System including a single pre-assembled, integrated package unit in a welded aluminum frame consisting of chlorinator, effluent pump, effluent pump with VFD, electrical box, micro-processor controller, balance tank, and appurtenances, as shown on the Drawings and specified herein.

1.02 SYSTEM

- A. Packaged Calcium Hypochlorite Tablet-based Chemical Feed Equipment System Accu-Tab® 3075 PowerPro® (Axiall Corporation), or approved equal, with the following features:

Tag Number	20-P-410
System Name	Dry Chlorine System
Source Water	Groundwater
Source Water Flow Rate	500 gpm
Design Operation Point	Maintain 1.0- to 2.0 mg/l chlorine residual downstream of Hydropneumatic tank
Maximum chlorine solution level	0.05% (500 ppm)
Chlorine Source	Dry Calcium Hypochlorite, tablets
Effluent Pump	Grundfos CR series or equal
Effluent Pump Drive	Variable Frequency Drive
Residual Controller	Residual, flow, and compound loop control options
Controller Tag Number	20-CP-410
Power	480 volt, three phase
Location	Outdoors, under a sunshade
Residual Chlorine Meter	See Specification 13431 – Instrumentation and Control – Analytical Devices, installed as shown on the Drawings, signal run to micro-processor controller
Temperature range for all system components including electronics & controls	25 deg F to 122 deg F

- B. Batch systems with pressure mixing components producing chlorine concentrations exceeding the limits of the specifications will not be considered.

1.03 SYSTEM FEATURES

- A. A maximum chlorine solution level of 0.05% (500 ppm) shall be maintained to prevent calcification in system components. Systems producing chlorine concentrations higher than 0.05% shall not be acceptable.
- B. Delivery shall be by erosion feed technology to control accurate and consistent concentration limits in the chlorine treatment solution. Spray and/or vortex technology systems shall not be acceptable.
- C. The chlorinator shall automatically and continuously feed a limited quantity of chlorine in solution as needed. Batch systems preparing excess quantities of solution for delivery over an extended period shall not be acceptable.
- D. A centrifugal pump with VFD wired to the system electrical box and connected to the chlorine residual controller shall feed freshly mixed chlorine treatment solution only as required for maximum efficiency. Batch systems requiring the use of a metering pump or pumps to feed pre-prepared standing solution shall not be acceptable.
- E. All piping in the system shall be Schedule 80 PVC. Systems with flexible tubing shall not be acceptable.
- F. System and/or all wetted components shall be NSF 61 certified And NSF Standard 60 listed calcium hypochlorite tablet

1.04 SUBMITTALS

- A. Shop drawings showing details of fabrication, erection, and adjoining equipment interfaces for all equipment furnished under this Section.
- B. Manufacturer's rating curves showing dosing characteristics, pump characteristics of discharge, head, capacity, brake horsepower, efficiency, required net positive suction head, and other included appurtenances.
- C. Literature and drawings describing the equipment in sufficient detail, including parts list and materials of construction, to indicate full conformance with the Specifications.
- D. Certified dimensional drawings of each item of equipment and auxiliary apparatus to be furnished.
- E. Foundation and anchor bolt plans and details.
- F. Schematic electrical wiring diagrams and control panel drawings and other data as required by the Engineer.
- G. Operation and Maintenance Manual.

1.05 QUALITY ASSURANCE

- A. All equipment furnished under this Section shall: (1) be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years; and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.

PART 2 - PRODUCTS

2.01 SYSTEM COMPONENTS

- A. Furnish and install a pre-fabricated Packaged Hypochlorite Chemical Feed Equipment System whose major components are listed below.
- B. Tablet Chlorinator. The Accu-Tab® 3075 MD PowerPro chlorinator by Axiall Corporation is designed exclusively for Accu-Tab SI calcium hypochlorite tablets by Axiall Corporation. Tablets are placed on a sieve plate inside the chlorinator; as water flows across the sieve plate, the tablets erode at a rate proportional to the flow rate.
- C. Inlet Water Supply Connection with Filter: 1" FNPT
- D. Inlet Solenoid Valve. Opens and closes on command when the system receives a signal. 110 VAC required.
- E. Rotometer. Measuring the flow of the fresh water-dissolving stream.
- F. Flow Control Valve. PVC gate valve mounted in line with the flow meter allows operator to adjust flow of water-dissolving stream.
- G. Solution Tank. Fabricated of high-density polyethylene. Capacity is 69 gallons.
- H. Primary Solution Tank Level Control. Made from Schedule 80 PVC and 316L stainless steel, this float valve meters the tablet by-pass flow. The by-pass stream balances the variation in the water-dissolving stream. The float valve opens or closes to maintain the pump rate as it is throttled.
- I. Secondary High/Low Level Solution Tank Control. Prevents the solution tank from overflowing. High level: when activated, a switch opens the circuit to the solenoid valve, causing the valve to close. Low level: shuts pump down preventing cavitation. A restart timer will prevent the pump from "chattering".
- J. Solution Delivery (Effluent) Pump. Delivers chlorinated solution into a pressurized stream. A 480v single stage centrifugal pump (Grundfos CR or equivalent) is standard with performance of 30 gpm @ 80 PSIG.
- K. Solution Injection Pump Air Bleed. Used to prime the pump at start-up, or at any time, if necessary. Also functions as a recycle line for tank cleaning.

- L. Primary Backflow Prevention. A PVC Ball check valve prevents reverse flow of water into the system.
- M. Discharge Control Valve (manual). Used to balance system output water flow with system input water flow.
- N. Outlet Connection. 1" FNPT.
- O. Nema 4X Electrical Enclosure. UL Listed components. System operates in HAND mode. A run signal shall be used to start/stop the system in an AUTO mode. The run signal shall be a dry contact wired from the well pump's control panel. in AUTO mode, the chlorination system only operates when the well pump operates. This is field wired to the terminal block.
- P. Aluminum Frame, Type 6061-T.
- Q. Pressure regulator and gauge (inlet pressure upstream of regulator will be 90 PSIG).
- R. Inlet Pressure Gauge. Liquid filled 0 to 100 PSIG shall be included
- S. WEG Variable Frequency Drive (VFD) suitable for use with Effluent Dosing Pump.
- T. Weight Scale. Load cell factory-installed under the chlorinator to measure tablet weight.
- U. ATC 1000 Micro-Process Controller: A separate touch screen process controller that will allow residual, flow pace or compound loop control.
- V. ATC 1000 Micro-Process Controller outputs:
 - a. Provides 2, 4020 mA DC outputs
 - b. Provides 5, dry contract outputs
 - c. These can be used to report out: pump run status, solution tank low level, solution tank high level, low dry chorine tablet weight; and inlet solenoid valve open/closed.
 - d. Equipment supplier shall coordinate with Contractor on dry contract identification for Contractor routing to Building Management System.
- W. As part of package supply scope, Equipment supplier shall provide a system that integrates VFD control with the ATC 1000 Controller to meet the selected dosing strategy.

2.03 PAINTING

- A. Non-stainless steel components shall be painted in accordance with Equipment supplier's recommendations and Specification 09960.

1.04 ELECTRICAL SYSTEM REQUIREMENTS

- A. (1) pump circuit sized for the pump/motor provided, and shall operate on 480 VAC Three phase power.

1.05 WARRANTY

- A. The Equipment supplier shall guarantee in writing that this unit, if operated in accordance with written instructions given and accepted by the Owner, will perform in complete accord with the specifications. All components shall be warranted against manufacturers' defects for twelve (12) months from its original installation date. Only Accu-Tab® SI tablets can be used in these chlorination systems. Use of any other tablet will invalidate the warranty.

PART 3 - EXECUTION

3.01 DELIVERY AND STORAGE

- A. Equipment shall be crated and delivered to protect against damage during shipment.
- B. Parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the equipment is ready for operation.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the Engineer.
- D. The finished surfaces of exposed flanges shall be protected by wooden blank flanges, strongly built and securely bolted thereto.

3.02 INSTALLATION

- A. The equipment shall be installed in accordance with the instructions of the supplier and as shown on the Drawings.
- B. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.
- C. Submit a certificate from the Equipment supplier stating that the installation of his equipment is satisfactory, that the equipment is ready for operation, and that the operating personnel have been suitably instructed in the operation, lubrication and care of each unit.

3.03 FIELD QUALITY CONTROL

- A. The supplier's technician shall prepare a written report specifying that the equipment is installed per the manufacturer's recommendations and is ready for permanent operation. The report shall also confirm that nothing in the installation will render the manufacturer's warranty null and void.
- B. The supplier shall provide the services of a factory-trained technician to train the Owner. Provide a minimum of 16 hours of field training.

- C. All adjustments necessary to place the equipment in satisfactory working order shall be made at the time of the above tests.

3.04 EQUIPMENT TESTING

- A. After the complete packaged system and appurtenant equipment have been installed, and the units have been inspected, preliminarily tested, adjusted and placed in proper operating condition under the supervision of the Equipment supplier's representative, the entire system shall be field tested in the presence of the Engineer. The tests shall demonstrate fitness for the service specified and the ability of the system to operate without vibration or overheating when operated to meet the performance requirements specified. All alarms and adjustments to the system shall be tested and witnessed by the Engineer.
- B. The results of all tests shall be submitted to the Engineer for approval.
- C. All adjustments necessary to place the equipment in satisfactory working order shall be made at the time of the above tests.

3.05 FINAL ACCEPTANCE AND WARRANTY

- A. Final acceptance of all equipment furnished under these Specifications will be withheld until after the installation and satisfactory field testing. The manufacturer and the Contractor shall warranty the equipment against defects of any kind for a period of one year after Substantial Completion, as long as the system is operated in accordance with written instructions given. Only Accu-Tab SI tablets can be used in these chlorination systems. Use of any other tablet will invalidate the warranty.

END OF SECTION

SECTION 114011

AMMONIUM SULFATE CHEMICAL FEED EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Provide complete, tested and operating ammonia (ammonium sulfate) feed equipment as shown on the Drawings and as specified herein.

1.02 REFERENCES

- A. Uniform Fire Code (UFC)
- B. California Building Code (CBC)
- C. National Electrical Manufacturers association (NEMA)
- D. American Society for Testing and Materials (ASTM)

1.03 SUBMITTALS

- A. Shop Drawings and Product Data: Submit the following as a single complete initial submittal in accordance with Section 01300:
 1. Product data to demonstrate that equipment conforms to the specifications.
 2. Motor data as required in Division 16
 3. Pump layouts and dimensions.
 4. Pump performance data.
 5. Materials of construction.
 6. Anchorage calculations for the equipment meeting the requirements set forth by Contractor Design Engineer
 7. Seismic certification of all equipment, certifying that the equipment is designed to resist any internal loading to be developed by Contractor Design Engineer.
- B. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists for each system specified.
- C. Affidavits: Furnish affidavits from the manufacturer stating that the equipment has been properly installed, adjusted and tested and is ready for full time operation.

- D. Safety Data Sheets (SDS) for each chemical to be used during testing of each chemical feed system.

1.04 QUALITY ASSURANCE

- A. All equipment furnished under this Section shall: (1) be of a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five years; and (2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.
- B. All components and equipment shall be suitable for bulk (as delivered) chemicals, whose responsibility to supply is the Contractors, specified as follows in percentage by weight of solution (approximate):

Chemical	Concentration	Approximate Specific Gravity
Ammonia (Ammonium Sulfate)	40%	1.23

- C. Comply with the Following Regulatory Standards:

1. Uniform Fire Code, especially Article 80, Hazardous Materials with local amendments, if any.
2. California Building Code.

PART 2 - PRODUCTS

2.01 CHEMICAL SKID

- A. Pumps shall be positive displacement, electronic solenoid actuated diaphragm type. This specification addresses skid mounted chemical metering pump systems complete with the skid assembly containing chemical metering pumps, all necessary piping, valves, fittings, supports, electrical controls, and accessories as specified herein. The metering pump skid shall contain the following items:
1. Skid with drip lip
 2. Metering pumps with manual stroke length adjustment
 3. Calibration column
 4. Pulsation dampeners
 5. Pressure gauges with diaphragm seals
 6. Ball valves
 7. Pressure relief valves
 8. Backpressure valves
 9. All piping, valves, gaskets, supports, hardware, wiring, and accessories necessary for a fully functioning skid.
- B. Skid shall be specially designed, constructed and installed for the service intended

and shall comply with the conditions listed in the schedule at the end of this Section. The supplier shall submit compatibility data from the manufacturer being supplied to confirm the materials of construction.

C. The skid mounting of the metering pumps shall conform the following requirements:

1. Each chemical feed system shall be completely assembled, mounted, calibrated, tested, and delivered to the site on a single skid. Components to be mounted on the skid are as indicated on the drawings and shall include the metering pumps, calibration column, piping, valves, piping accessories (pulsation dampeners, strainers, etc.), and wiring integral to the skid. The chemical feed system supplier shall be responsible for providing all equipment, valves and piping within the skid boundary.
2. The skids shall be constructed of fusion welded polypropylene sheets with adequate supports for all equipment and piping. Fork lift truck cut outs be provided.
3. All components of the skid-mounted system (pumps, piping and controls) shall be tested prior to shipment as described in Part 1.2.D.

2.02 DIAPHRAGM PUMPS

A. Type: Chemical metering pumps shall be simplex head, electrically-actuated diaphragm type pump. The chemical metering pump speed shall be controlled by an adjustable frequency drive (AFD).

B. Chemical Metering Pump Schedule:

Qty	Description	Chemical Solution	Minimum Capacity (GPH)	Design Pressure (psi)	Min. Pump Pressure (psi)	Min. Motor (HP)	Model No.
1	Ammonia (20-P-510)	Ammonium Sulfate	0.2	250	80	N/A	LMI AD941-928NI Pump

C. Construction:

1. Metering pumps shall be designed to handle the chemicals in the concentrations noted. Metering pumps shall be located as shown on the Drawings.
2. Each metering pump shall be a complete assembly including head, diaphragm, and integral double ball check valves. The pump valves shall be removable for cleaning or replacement without the need to disconnect the suction or discharge piping.
3. Each metering pump shall be capable of continuous operation at zero stroke and flow.

4. The pump shall have an internal relief valve, which is externally adjustable.
5. Stroke Positioner:
 - a. In addition to the variable frequency drive, each metering pump shall have a manual stroke length adjustment with a minimum 10:1 range and indicator reading 0 to 100%.
6. Materials: Metering pumps shall use the following materials for wetted parts and seals.
 - a. Wetted Parts: Wetted parts include head, diaphragm, ball checks and any other parts in the head assembly which normally are in contact with the pumped chemical.

Chemical Solution	Wetted Parts	Diaphragm
Ammonium Sulfate	PVC/Viton	Teflon

- b. Seals: All seals shall be made of materials, which are suitable and recommended for the chemical service.
- C. Flow Requirements: Metering pump capacity shall be as specified in the schedule. Ratings are specified at 100% controller speed output. Metering pumps shall have a repeatability of 1% of full scale, given constant suction and discharge pressures.
- E. Motors: Motors shall be AC, supplied with TEFC or severe duty enclosures. The motor shall be 1 HP minimum. See Electrical specifications for additional requirements.
- F. Seismic: Entire pump and installation shall comply with the seismic requirements to be developed by Contractor Design Engineer.

2.03 CHEMICAL FEED SYSTEM ACCESSORIES

- A. General: Materials of construction shall be satisfactory for continuous exposure to the hereinbefore-listed chemicals.
- B. Piping Specialties:
 1. Provide properly sized pulsation dampeners with pressure gauges on the discharge pipelines of each metering pump and suction pipelines as shown on the Drawings. Provide Viton bellows in the pulsation dampeners for hypochlorite service and EPDM bellows in the pulsation dampeners for all other chemical services.
 2. Provide pressure relief valves with pressure gauges and backpressure valves with pressure gauges for all services. Valves shall be of PVC except caustic service which shall be 316 stainless steel. Provide Teflon diaphragms in all pressure relief and backpressure valves. Valves for caustic and hypochlorite shall have flanged connections only. Valves shall be field adjustable and installed

where shown on the Drawings and/or as recommended by manufacturer. Valves shall be by Top Valves supplied by Primary Fluids; Jesco America Corporation; Wallace & Tiernan; or equal.

3. Provide discharge pressure gauges for each pump with features and accessories in accordance with Manufacturer recommendations.
- C. Chemical Piping Flexible Connections: Provide hoses made from reinforced PVC where shown in the chemical piping systems on the Drawings. Hoses shall be not less than 6 inches long at the suction and discharge connections to the metering pumps. Hoses at tanks shall be not less than 18 inches long. Each chemical metering pump shall have a flexible connection in the suction and discharge piping. Each tank shall have a flexible connection in all suction piping runs shown on the Drawings. The flexible connections for the hypochlorite tank and caustic soda tank shall be flanged.
- D. Calibration Cylinders: Provide one, clear plastic calibration chamber with vent for use in calibrating the metering pumps. The chamber shall be sized to give adequate capacity for a minimum 60 second draw down test. The scale shall give direct readings in GPH without the need for calculations. The calibration chamber shall be piped and valved so that each pump shall be able to utilize the calibration chamber without interfering with the operation of the other pumps. The top of the chamber shall have a threaded fitting to allow for piping to a common vent.

2.04 MANUFACTURER

- A. Provide diaphragm chemical metering pump skids and appurtenances as manufactured by one of the following:
1. J.L. Wingert Company
 2. Or pre-approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: The chemical feed system equipment shall be installed in strict conformance with the manufacturer's installation instructions and with favorably reviewed shop drawings. Check out of the final installation, startup, calibration and instruction of operating personnel shall be performed by an authorized representative of the manufacturer.

3.02 IDENTIFICATION

- A. Identification of the health, flammability, and reactivity of each chemical shall be affixed above each chemical feed area.

3.03 FIELD TESTING

- A. Each chemical feed system shall be tested for four hours with potable water. Each chemical system shall be tested against a closed discharge solution pipeline to test pressure relief valve operation. This shall be performed for each metering pump and shall be witnessed by the Engineer. Only after satisfactory testing with water and complete draining and removal of water from the chemical system, and thorough drying, which may require blowing oil-free dry air through the pipelines, may the final test with chemical be allowed to proceed. After draining the test water, hand wipe, dry and blow dry air through chemical feed pipelines to leave the chemical pipelines clean, dry and ready for conveyance of the chemical; then test each chemical feed system in all operational and alarm modes to show conformance with these Specifications. Provide sufficient chemical (approximately 55 gallons each), for the test. The chemicals used for the field test shall be favorably reviewed by the Engineer prior to the test. Each chemical metering pump shall be (chemical solution) calibrated and tested throughout its pumping range. The SDS for each chemical shall be on hand during the testing of each chemical feed system.
- B. Dispose of water used for testing (and cleaning if applicable to the section).

3.04 FIELD SERVICES

- A. Provide an engineer or technician from the chemical feed equipment supplier(s) to make all adjustments and monitor the testing specified in paragraph 3.03 above.
- B. After successful completion of field testing, provide two days (16 hours) of additional service by an engineer or technician from each equipment supplier to train plant personnel in system operation, maintenance, and safety procedures.

3.05 FINAL ACCEPTANCE AND WARRANTY

- A. Final acceptance of all equipment furnished under these Specifications will be withheld until after the installation and satisfactory field testing. The manufacturer and the Contractor shall warranty the equipment against defects of any kind for a period of two years after Substantial Completion.

END OF SECTION

SECTION 13200
HYDROPNEUMATIC TANK

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: This section provides specifications for the design and construction of hydropneumatic pressure vessels for the Plant Water system as shown on the Drawings, and as specified herein.
- B. Related Sections
 - 1. Section 02900: Disinfection
 - 2. Section 09960: Protective Coatings
 - 3. Section 15050: Basic Mechanical Materials and Methods

1.2 REFERENCES

- A. American Society of Mechanical Engineers (ASME)
 - 1. Boiler and Pressure Vessel Code, Section VIII – Rules for Construction of Pressure Vessels, most recent edition.

1.3 SUBMITTALS

- A. Initial Submittal:
 - 1. Submit two sets of complete shop drawings and descriptive literature for City review. Drawing shall include all critical dimensions and show locations of all fittings and appurtenances. Drawings shall also show detailed that are necessary for proper fabrication of the vessel and appurtenances.
 - 2. Submit procedures for welding of tank joints and welder qualifications.
 - 3. Submit Inspector Qualifications (verification of compliance with Section UG-91 of the Boiler and Pressure Vessel Code.
- B. One set of the reviewed shop drawings will be returned to the Contractor, authorizing the tank fabricator to proceed with the fabrication of the vessel.
- C. With the delivery of the vessel, the Contractor shall supply in accordance with Section 01300:
 - 1. Final shop drawings (revised if corrections were made on the reviewed set of drawings).
 - 2. Reports certifying that all materials, tests, and fabrication are in accordance with Section UG-120 of the Boiler and Pressure and Vessel Code. (see Manufacturer's Certificates, Section 01300, paragraph 1.09)

1.4 QUALITY ASSURANCE

- A. Vessel shall be fabricated by a company with experience in the construction of steel pressure vessels. All welding shall be done by experienced, skilled operators familiar with the methods and materials to be used. Engineer shall have final

approval over selection of the vessel fabricator.

- B. Regardless of any approvals given by the Engineer, the Vendor shall be solely responsible for the work and material fulfilling in every respect to the requirements of ASME code specified herein.

PART 2 - PRODUCTS

2.1 HYDROPNEUMATIC TANK (20-T-200)

- A. The volume of the hydropneumatic tank shall be a minimum of 3,600 gallons and an outside diameter of 72 inches. The hydropneumatic tank must have no moving parts, vanes or elastomers and shall contain a vortex breaker.
- B. The hydropneumatic tank shall be constructed of carbon steel for a Maximum Allowable Working Pressure (MAWP) of 125 psig in accordance with the ASME Pressure Vessel Code, Section VIII, Division 1. The minimum wall thickness shall be ¼ inch. The hydropneumatic tank shall be provided with a flanged line connection (6 inch), adequate supports (two saddles for horizontal), lifting lugs and couplings for drain, safety relief valve and control system. The hydropneumatic tank shall be provided with an elliptical manway, minimum 14" x 18".
- C. Hydrostatic test the hydropneumatic tank in accordance with ASME Code for Unfired Pressure Vessels. Form U-1A "Manufacturers' Data Report for Unfired Pressure Vessels" shall be provided by the hydropneumatic tank manufacturer to certify that the hydropneumatic tank was built in accordance with ASME Code Rules for the Construction of Unfired Pressure Vessels and inspected by a certified inspector. Copies of this form shall be supplied with the hydropneumatic tank and included in the Operation and Maintenance Manual.
- D. Vendor shall coat the tank interior and exterior using materials and procedures specified in Section 09960, Protective Coatings.

2.2 CONTROL COMPONENTS

- A. The Automatic Pressure Control System includes Pressure Controller, Level Transmitter, Solenoid Valves and Air Compressor.
 - 1. The PLC based pressure controller is located in the Control Panel (20-CP-200) shall be a PULSCO Skypark Series or approved equal.
 - a. All electronics shall be housed in this 304 SS NEMA 4X Control Panel enclosure, referred to herein as the Control Panel. This Control Panel is separate from the pneumatic assembly enclosure (see below). Also, Contractor shall route power to the Control Panel and be responsible for all wiring associated with powering and controlling all other Hydropneumatic Tank Supplier equipment scope from this Control Panel.
 - b. Controller shall be pre-mounted onto the hydropneumatic tank.
 - c. Controller shall be equipped with a door mounted 12" HMI touch screen display with a built in proximity sensor that will put the display to sleep if no movement is detected for several minutes.

- d. HMI shall contain screens that have continuous indication of water level and corresponding tank water volume in real time that displays current water level in relation to solenoid and alarm level set points.
 - e. HMI shall contain screens that display and allow changes to current solenoid and alarm level set points and timers.
 - f. A button on the HMI shall be provided that resets all values to pre-programmed O&M values.
 - g. Vent and Add air solenoid control shall be selectable from hand, off, and auto from the controller display.
 - h. HMI shall contain an alarm screen that lists the alarms that have occurred and the number of occurrences that each alarm has had.
 - i. Controller shall log and save locally all alarms and input signals for a minimum 3 months.
 - j. All field wiring to the controller shall be done through heavy duty connectors. There shall be no field wiring to components inside of the controller.
 - k. Multiple heavy duty connectors shall be provided to separate AC and DC voltages.
 - l. Electrical surge suppression devices shall be installed on all analog input signals.
 - m. Dry contacts shall be available for all alarm, solenoid relays, and pump starts.
 - n. Controller shall contain a managed Ethernet switch to allow Ethernet communication with site PLC or SCADA system.
2. Level Transmitter. Level transmitter provides a 4-20 mA signal and can be a Differential Pressure Transmitter, Magnetic Level Transmitter, or R.F Capacitance probe.
 3. Pressure Transmitter. Pressure transmitter provides a 4-20 mA signal. The range shall span the operating pressure range plus margins at each end. The pressure connection for the pressure transmitter shall be at the instrument well or on the top of the hydropneumatic tank. The pressure signal shall control the pump turn on point, add/vent air solenoid valves and provide high and low pressure alarm signals.
 4. Solenoid Valves. ASCO Redhat model or equal. One solenoid valve for adding air (raising tank pressure) and one solenoid valve for venting air (lowering tank pressure).
 5. Pneumatic Assembly. Solenoid valves and associated ball valves and piping shall be pre-assembled by the supplier and installed in a NEMA 4 enclosure. Contractor shall be responsible for coordinating with the supplier and providing a fully operating system including all pipes, valves, and appurtenances for the Pneumatic Assembly.
 6. Air Compressor (20-CMP-200). The air compressor package shall be a Simplex (*one air-cooled, two-stage, oil lubricated reciprocating type air compressor mounted on one air receiver*) or a Duplex (*two air-cooled, two-stage, oil lubricated reciprocating type air compressors mounted on one air receiver*). Air Compressor(s) shall include all necessary piping (tubing) for connection to the air receiver and all components wired to the air compressor motor starter box. The air compressor package shall be the standard product of a manufacturer who is

regularly engaged in the design and construction of fully automatic air compressor systems. The air compressor system shall include the following items.

- a. A Totally Enclosed Fan Cooled (TEFC) motor shall drive the compressor and shall be adequate to drive the compressor continuously at full-rated output. Power supply shall be 230/460 volts, 3 phase and 60 hertz.
- b. The Hydropneumatic Pressure Control System supplier shall select the compressor volumetric capacity and discharge pressure. The capacity and discharge pressure selected shall be sufficient for the application to adjust the pressure from the add air setpoint to the add air reset in no more than 20 minutes.
- c. Compressor unit shall include a totally enclosed crankcase of cast iron, separate detachable deep finned cylinders, matched balanced pistons, separately removable valve housing, low oil switch and a direct reading pressure gauge. The low oil switch shall shut down the compressor if the oil level is too low. The switch shall not reset without adding oil.
- d. The air compressor controller (20-CP-201) shall be provided with a power on light, Hand-Off-Automatic (HOA) switch, run light, motor overload alarm light and low oil level alarm light. The controller shall contain a magnetic motor starter and 120V power supply. The controller shall be pre-mounted onto the air compressor.
- e. The air compressor shall start and stop based on pressure in the air receiver. Dry contacts shall be provided in the controller for remote indication of running conditions for the compressor. The compressor shall be shutdown by motor overload, or low oil level. An alarm condition shall energize a local alarm light.
- f. The compressor shall start automatically, provided its HOA switch is in the AUTO position. The compressor shall run continuously if its HOA switch is in the HAND position and shall shut down if its HOA switch is in the OFF position.
- g. The air receiver shall be a minimum of 80-gallon capacity.
- h. The air compressor package shall be coated with the standard factory coating.

2.3 MISCELLANEOUS COMPONENTS.

- A. $\frac{3}{4}$ " Safety Relief Valve. The pressure tank shall have a safety valve sized in accordance with the ASME code to prevent over pressurizing the pressure tank above its design pressure. Safety Relief Valve setpoint shall be set to the maximum allowable working pressure of the pressure tank.
- B. Check valve for air line.
- C. A valve shall be installed on the top of the tank to prevent fluid from ever being able to enter the air piping.
- D. Ball valves for isolation and bypass of solenoid valves, isolation and drain of the probe well and drain and isolation of the air piping.
- E. Instrument Well. Stainless steel chamber with couplings for connection to pressure tank and installation of level transmitter, level indicator and drain valve to allow for easy troubleshooting of the system.

- F. Level Gauge Assembly - A level indicator shall be mounted on the instrument well for visually checking pressure tank water level. The indicator's connections shall have isolation valves. Indicator shall extend from approximately 6" below and 6" above the designed operating range.
- G. Air Muffler for reducing the noise generated from the venting of air from the pressure tank.
- H. Pressure Gauge for indicating pressure in pressure tank, 4 ½" diameter dial, ¼" bottom connection.
- I. Compressed air piping connecting the pneumatic assembly with the air compressor and the hydropneumatic tank shall be ¾" copper pipes to be provided by the Contractor.

2.4 NOT USED

PART 3 – EXECUTION

3.1 FABRICATION

- A. Backing rings shall not be used for a permanent part of the fabrication. All interior joints and connections shall be seal welded. There shall be no voids in the interior of this vessel.
- B. Nozzles shall be flush internally to facilitate coating.
- C. Intermittent welds shall not be used on the vessel assembly. All welds to be continuous to eliminate any voids.

3.2 SURFACE PREPARATION

To facilitate coating, all weld spatter and rough welds shall be ground smooth. All sharp edges shall be rounded and ground smooth.

3.3 SHOP INSPECTION AND TESTING

- A. The tank shall be inspected in accordance with Sections UG-90, and UG-92 through UG-97 of the Boiler and Pressure Vessel Code by an Inspector employed by an ASME accredited Authorized Inspection Agency
- B. The tank shall be subject to Hydrostatic Testing as outlined in Section UG-99 of the Boiler and Pressure Vessel Code.
- C. Upon favorable review of the Tank Data Report, the vessel shall be cleared for coating.

3.4 COATING

- A. On certification of vessel (through incorporation of ASME stamp), the Contractor shall authorize coating of the tank interior and exterior as specified in Section 09960, Protective Coatings.

3.5 DELIVERY AND TOUCH-UP

- A. After final cure and inspection at the fabrication site, all opening(s) in the vessels shall be plugged or sealed with metal or wooden covers for shipping. Vessel shall be delivered to the jobsite.
- B. Upon delivery, Engineer shall inspect the vessel for defects in the prepared surfaces and applied coating. Should defects be found in the prepared surfaces of applied coatings, Contractor shall perform touch-up procedures until the prepared surfaces and applied coatings are found to be free from defect. Any additional inspection work is to be done under the provisions of Section 09960.

3.6 INSTALLATION

- A. The tank supports shall be anchored to its mounting pad as indicated on the Drawings and as outlined in Section 15050 of the Specifications.

3.7 DISINFECTION

- A. Disinfect the tank following the procedure outlined in Section 02900 of the Specifications

END OF SECTION

SECTION 13410

PROCESS INSTRUMENTATION AND CONTROLS, GENERAL PROVISIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. A single Process Control System Integrator (PCSI) shall furnish all services and equipment for the City of East Palo Alto (City), Pad D Standby Well controls, local communication networks, local interfaces to remote communication networks, and project field instrumentation as specified herein.
- B. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and Subcontractors to review all sections to insure a complete and coordinated project.
- C. The PCSI shall be responsible for the programming of all PCSI supplied SCADA components. This includes but is not limited to: PLC, HMI, network switches, instrumentation, etc. Programming required for packaged systems instrumentation and/or automation, such as the hydropneumatic tank system PLC and tablet chlorination system PLC, are to be provided by the Packaged System Supplier (PSS). The PCSI and PSS shall coordinate control interfaces designated in the Contract Documents and as required for a fully functional system.
- D. Equipment shall be fabricated, assembled, installed and placed in proper operating condition in full conformity with the Contract Documents and drawings, engineering data, instructions, and recommendations of the equipment manufacturer as approved by Engineer.
- E. The work shall include furnishing, installing and testing the equipment and materials detailed in the following Specification Sections:
 - 1. Section 13415 – Process Control Descriptions
 - 2. Section 13420 – Control Panels and Hardware
 - 3. Section 13421 – SCADA Controls Hardware and Software
- F. Where differences exist between the specific equipment Specification Sections of Division 13 and this general equipment Specification Section, the specific equipment Specifications shall govern.

1.02 SCOPE OF WORK

- A. The PCSI work shall include the following:
 - 1. Provide all materials, equipment, labor and services required to achieve a fully integrated and operational system. The PCSI shall design and coordinate the instrument and process control system for proper operation with related equipment and materials furnished by others under other Sections of these Specifications.
 - 2. All field instrumentation, sensors, analyzers, and devices as shown on the Drawings and as specified for monitoring and control functions as specified in Section 13415.
 - 3. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, signal isolators, or relays to interface with

equipment provided by others under other Sections of these Specifications whether they are shown on the Drawings or not.

4. Schedule and facilitate Coordination Workshops as specified herein.
 5. Provide all programmable logic controller (PLC) programming and configuration including development of control programs, database configuration, network configuration, communication links, and other programming tasks as specified herein.
 6. Provide all Human Machine Interface (HMI) programming and configuration including development of graphic displays, alarm handling, and local trending.
 7. Software developed by the PCSI under this contract shall be coordinated with the City as part of the programming workshops specified below. Control system configuration by the PCSI shall include the following:
 - a. Perform real-time process control, including proportional integral derivative control action, individual equipment starts and stops sequencing, process calculations, etc. as described in Section 13415.
 - b. Assist operating personnel by noting and communicating off-normal operating conditions and equipment failures at remote sites.
 - c. Accumulate and store equipment running times for use in preventative maintenance.
 - d. Provide color graphic displays for use by the system operating and supervisory personnel.
 - e. Provide trending for all analog values.
 - f. Provide control system diagnostics.
 - g. Allow the operator to manually control, (by touch screen entry and defined function keys) as well as view the status of pumps, valves, etc. (i.e., On-Off, Open-Close, setpoint value, etc.) when viewing the appropriate graphic screen on the HMI.
 8. Perform all process control functions including PID, calculations, sequencing, timing, etc., in the PLCs. The HMI software shall perform the real-time database, graphic screens, set point modification, short term data archiving, etc. No real-time process control shall be implemented at the HMIs.
 9. Provide, configure and, commission cellular based autodialer system.
 10. Provide complete system documentation coupled with testing and training services as specified in Part 3 of this specification section.
- B. The PCSI shall use the equipment, instrument, and loop numbering scheme that has been developed and shown on the Drawings. The PCSI shall also utilize the process control descriptions located in Section 13415 in the development of the PCSI's submittals. The PCSI shall not deviate from or modify said numbering scheme or process control logic without Engineer's approval.
- C. There are two water quality sample streams that will have the following instruments a specified herein and shown on the Drawings:
1. Free chlorine: free chlorine that will operate over the following pH range: 7 to 9
 2. Total chlorine: Pre-Blending: pH, temperature, and total chlorine, that will operate over the following pH range: 7 to 9

3. Each of the two sets of instruments shall be panel mounted, for a total of two panels. Each panel shall be configured for one flow thru sample supply line coming in, and one drain line out of each panel.

D. Reagents

1. Analyzers' equipment and layout are designed around first named equipment supplier. The purpose of the design is to minimize reagent use. The only reagent associated with first named suppliers' scope is a vinegar-based reagent (5% Acetic Acid - .0055 Potassium Iodide Solution) whose MSDS Hazards Identification are as follows: Health Rating:1; Flammability Rating: 0; Reactivity Rating: 0, and Contact Rating: 1. This reagent is not an anticipated or known carcinogen.
2. Manufacturer's not named in these specifications shall submit evidence in the form of MSDS Hazard sheets that their reagents are of similar quality and volume (5 gallons over 60 days) to be considered an as-equal.

E. Related Work

1. Section 16120: Instrumentation signal cable, alarm, status wiring, other conductors and associated terminations and requirements.
2. Appendix 13410-A: Input/Output (I/O) List. The I/O List is included for reference only. The determination of the exact number and type of I/O points shall be the responsibility of the PCSI based on the Process Control Loop Descriptions per Section 13415, auxiliary device requirements, and spare requirements as shown on the Drawings and specified herein.
3. Appendix 13410-B: Field Instrument List. The Field Instrument List is included for reference only. Only major instruments are included in the Field Instrument List and miscellaneous switches, relays, valves, signal conditioners, process seals, manifolds, and auxiliary devices are not included. Providing all instruments and devices necessary for a fully functioning system shall be the responsibility of the PCSI, based on the Process Control Descriptions per Section 13415, auxiliary device requirements, and spare requirements as shown on the Drawings and specified in these Specifications.
4. Seismic requirements and anchorage shall be as specified under Section 01612.

1.03 SUBMITTALS

- A. General: Shop drawings shall be submitted as specified in Section 01300. They shall be complete; giving equipment specifications, details of connections, wiring, ranges, installation requirements, and specific dimensions. Submittals consisting of only general sales literature will not be acceptable.
- B. Coordination Workshops Agendas: Agendas shall be submitted for the Coordination Workshops as specified herein. Submit proposed Control System Coordination Workshop Agendas a minimum of four weeks prior to the scheduled workshop dates for review and comment by Engineer and modification by the PCSI as required.
- C. Field Instrumentation
 1. Submit complete documentation of all field instruments using ISA-S20 data sheet formats. Submit a complete Bill of Materials (BOM) or Index that lists all

instrumentation equipment ordered by the loop numbering system as shown in the Contract Documents.

2. Submit separate data sheets for each instrument including:
 - a. Plant or Site equipment number and ISA tag number.
 - b. Product (item) name used herein and on the Contract Drawings.
 - c. Manufacturer's complete model number.
 - d. Location of the device.
 - e. Input - Output characteristics (wiring, voltage, current ratings, etc.).
 - f. Range, size, and graduations in engineering units.
 - g. Physical size with dimensions, enclosure NEMA classification and mounting details in sufficient detail to determine compliance with the requirements of the Contract Documents.
 - h. Materials of construction for enclosure and wetted parts.
 - i. Instrument or control device sizing calculations where applicable.
 - j. Certified calibration data for all flow metering devices.
 - k. Two-wire or four-wire device type as applicable.
 - l. Submit index and data sheets in electronic format as well as hard copies on 8-1/2" x 11" formats. Electronic format shall be in Microsoft Excel or Word. Submit electronic copy on Read/Write CD-ROMs disks formatted for MS-Windows compatible personal computers.

D. SCADA Hardware Submittal

1. Catalog cuts and descriptive literature for programmable logic controllers (PLC), including central processing units, memory, input modules, output modules, modems or communication interfaces, network interface modules, mounting racks, and power supplies. Submit system bill of materials and descriptive literature for each hardware component that fully describes the units being provided.
2. Catalog cuts and descriptive literature for HMI software, peripherals, UPS units, and power supplies. Submit system bill of materials and descriptive literature for each hardware component, which fully describes the units being provided.
3. Complete system Input/Output (I/O) list for equipment connected to the control system under this Contract. The I/O list shall be submitted in both a Microsoft Excel readable electronic file format on a CD and an 8-1/2 inch by 11-inch hard copy. The I/O list shall include I/O name (or spare), type, physical location, point address, functional description (text that includes signal source, control function, etc.), range (Engineering units) and equivalent analog to digital "count" conversion, alarm limits (low-low, low, high, high-high, etc.), relay normal status contact configuration (i.e. relay logical condition for a normally open contact state or normally closed contact state). Both hard I/O and network/fieldbus datastream I/O shall be included. The I/O list shall be sorted in order by:
 - a. Physical location: Panel, Rack, CPU Name, or Remote I/O Drop
 - b. Source interface: Hardwired I/O, Ethernet or Modbus (network transfer)
 - c. I/O Type: AI, AO, DI, DO etc.

- d. Loop Number
 - e. Source device Tag
4. Complete block diagram showing the inter-connections between major hardware components, media type between components, raceway requirements (conduit, wireway, etc.), raceway identification, network protocol used at each network level, and all hardware components showing the interconnection of all modules, interface devices, modems, and plug-in circuit boards.
 5. UPS sizing calculations to verify compliance with the specified power usage and backup power duration requirements for equipment where required in the specifications or shown on the Drawings
 6. Submit power consumption (watts) of critical loads where shown on the Drawings.
- E. SCADA Software:
1. Submit details of the PLC and HMI application packages to be used. Indicate all standard and optional features provided. Include copies of license agreements indicating assignment of licenses to the City.
 2. Submit software logic and documentation for the program (function block diagram or ladder logic) used for the application engineering effort. Documentation and programming approach. At a minimum, each program module, subroutine, or function block shall be fully described in a program overview that defines the scanned inputs, scanned outputs, definition of constants and variables, and function of the routine. The program overview shall be stored as a separate word processing file for inclusion in the O&M manuals.
 3. Program documentation shall be comprehensive and include clear descriptions for all program elements (rungs, networks, function blocks, command descriptions, etc.) with abundant comments to clearly identify function and intent. For example, for ladder logic, the link between “coil” and “contact” shall be clearly presented (i.e. clear cross-reference between a coil and all instances of the associated contacts for that coil), the function of each timer described, the purpose of each subroutine call labeled and defined, etc. Similar level of documentation shall be provided for function block diagram or other approved programming approach as specified herein.
 4. Program documentation shall be sufficiently clear to allow determination of compliance with the process control requirements included in the Process Control Descriptions included in Section 13415 and the Drawings. The software submittal shall demonstrate that all logic provided under this project follows the same structure and format and reflects a consistent programming approach.
 5. Submit details of control system communication. Submit hardware and software configuration information in sufficient detail to verify performance of the communication systems. Include details of any necessary expansion boards, special interface requirements (e.g., cables, jacks, etc.), description of drivers and impact of drivers on controller memory configuration. Any specific communication block memory addresses shall be defined.
 6. Submit cross reference index of I/O allocation, controller memory address, HMI graphic systems address, and HMI graphic screen and/or script where the I/O

point will appear. Every physical I/O point as well as calculated or virtual I/O required for the implementation of the process scheme or as required for equipment assessment shall be included. Submit electronic version of the table in Microsoft Excel format.

7. Submit final drafts of logs, trends, and process graphic displays. The specifics of what shall appear on each display and report and what calculations are required to support them shall be described. Final drafts shall reflect the system requirements as specified herein as well as the result of the Coordination Workshops with the City and Engineer.
- F. Control Panel Submittal: Submittals and drawings shall be furnished for all panels, consoles, and equipment enclosures specified in Section 13420 and installed within the motor control center enclosure specified in Section 16442. Panel assembly and elevation drawings shall be drawn to scale and detail all equipment in or on the panel. As a minimum, the panel drawings shall include the following:
1. Interior and exterior panel elevation drawings to scale including dimensions of the MCC control section.
 2. Panel total weight including all components.
 3. Nameplate schedule.
 4. Conduit access locations for top or bottom entry.
 5. Panel construction details.
 6. Assembly and layout drawings to scale. The assembly drawing shall include a comprehensive bill of material on the drawing with each panel component clearly defined. The bill of material shall be cross-referenced to the assembly drawing so that a non-technical person can readily identify any component of the assembly by manufacturer and model number.
 7. Fabrication specifications.
 8. Panel control schematics and interconnection diagrams detailing the electrical connections of all equipment in and on the panel. Diagrams shall include at a minimum power and signal connections; UPS, and non-critical (normal) power sources; all panel ancillary equipment; protective devices; wiring, wire colors, and wire numbers; and terminal blocks and numbering.
 9. Control panel component catalog data and cut sheets for all control panel equipment provided.
 10. Heating and cooling calculations for the panel coordinated with the cooling calculations provided by the MCC enclosure supplier per Section 16442. Calculations shall include the recommended type of equipment required for both heating and cooling that will ensure maintaining the integrity of the NEMA panel rating.
 11. UPS and battery sizing calculations as required.
 12. Submit evidence that control panel shall be constructed in conformance with UL 508 and bear the UL seal confirming the construction. All costs associated with obtaining the UL seal and any inspections shall be borne by the Contractor and included in the Project Bid Price.
- G. Interconnection Diagrams

1. Interconnection Diagrams: Provide electrical interconnection diagrams depicting wiring between control panels, electrical equipment, and field instrumentation. Interconnection diagrams shall be provided for all power, control, signal, communications, and instrument wiring. Interconnection diagrams are not required for receptacle and lighting circuits.
 - a. Interconnection drawings shall be organized by process loop or conduit reference. To the extent possible, each drawing shall depict all interconnecting wiring associated with a specific loop including power sources, motor feeders, control connections and instrument connections.
 - b. Interconnection diagrams shall, as a minimum, show termination points at both ends of each interconnecting wire (including terminal block and terminal numbers), wire size, wire type, wire numbers, wire colors, wire routing (including all conduits, pull boxes, and junction boxes), and functional descriptions (e.g. Motor Running).
 - c. Field device wiring shall include the device ISA tag and City loop number as shown on the Drawings along with a unique numeric identifier consisting of the originating control panel, terminal block and terminal number where the wire lands with an additional alpha suffix if required to ensure uniqueness. For example:
 - 1) FIT0401K-CP24-TB2-12
 - d. Control panel to MCC wiring shall include the source control panel, terminal block, and terminal number followed by destination control panel, terminal block, and terminal number with an additional alpha suffix if required to ensure uniqueness; For example:
 - 1) MCC24-C1-12-CP24-TB1-56
 - e. Field wiring for analog points shall include wire labels for each conductor.
 - f. Two-wire and four-wire equipment shall be clearly identified and power sources noted.
 - g. All panel and field wiring shall be tagged and indicated on the electrical schematic. Submit final wire numbering scheme for approval by City.
 - h. Submit final circuit and cable labeling scheme for review and approval by the City prior to development of panel fabrication, connection, and schematic drawings.
2. Submit network diagram. The network diagrams shall contain the physical wiring layout showing connection types, cable types, junction boxes, terminals, and grounding requirements. Identify all equipment and physical location of each (enclosure, panel, etc.). Networked devices shall be shown with device equipment names, equipment descriptions, and IP addresses.

H. Testing Plan

1. Test Procedure Submittals: Submit the procedures proposed to be followed for each test. Procedures shall include test descriptions, forms, and checklists to be used to control and document the required tests. Include sign-off forms for each testing phase or loop (per the Specifications) with sign-off areas for the PCSI, the City, and the Engineer. Refer to Part 3 of this Section for testing requirements. Submit separate procedures for each specified test phases including:

- a. Unwitnessed Factory Test (UFT)
 - b. Witnessed Factory Test (WFT)
 - c. Operational Readiness Test (ORT)
 - d. Functional Acceptance Test (FAT)
 - e. 30-Day Acceptance Test.
2. Test procedure submittals must be submitted and approved by the Engineer at least 30 days prior to scheduling the associated test. The PCSI shall notify the City, in writing, at least two weeks prior to scheduling any witnessed testing. Testing notification shall include detailed schedules that describe the testing to be performed, the time the testing will commence, and the time the testing will be completed.
 3. Test Documentation: Upon completion of each required test, document the test by submitting a copy of the signed off test procedures. Testing shall not be considered complete until the signed-off test procedures have been submitted and favorably reviewed. Submittal of other test documentation, including "highlighted" I/O electrical schematic wiring diagrams with field technician notes are not acceptable substitutes for the formal test documentation.
- I. Training Plan
1. Training Plan Submittal: Training method and coverage shall be in conformance with the system training as specified herein. The training plan shall include:
 - a. Definitions of each course.
 - b. Specific course attendance.
 - c. Schedule of training courses including dates, duration and locations of each class.
 - d. Resumes of the instructors who will actually implement the plan.
- J. Spares, Expendables, and Test Equipment Submittal
1. Submit for each Subsystem:
 - a. A list of, and descriptive literature for, spares, expendables and test equipment to be provided under this Contract as required by the related technical Specification Sections of Division 13.
 - b. A separate list of, and descriptive literature for, additional spares, expendables and test equipment recommended by the PCSI.
 - c. Storage instructions for all spare parts.
 2. For Analyzers:
 - a. Provide spare parts, ancillary equipment, and device electrolytes or reagents per the specific equipment requirements listed in Part 2.
 - b. Provide all mounting hardware required for pipe stand, surface, or other mounting for all analyzers.
 - c. One year supply of consumables for calibration for all instruments requiring consumables for calibration.
 - d. Furnish additional accessories per manufacturer's requirements including spare lamps, fuses, gaskets, seals, connectors, cables, reagent or

chemical vials, light shields, desiccant cartridges, and standardized calibration references as applicable and as recommended for the unit furnished.

1.04 REFERENCE STANDARDS

- A. Publications are referred to in the text by basic designation only. Where a date is given for reference standards, that edition shall be used. Where no date is given for reference standards, the latest edition in effect at the time of bid opening shall apply.
- B. American Society for Testing and Materials (ASTM).
 - 1. ASTM A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- C. American National Standards Institute (ANSI)
 - 1. ANSI X3.5 – Flowchart Symbols and Their Usage in Information Processing
- D. International Electrotechnical Commission (IES)
 - 1. IEC 61131 - 3 – International Standards, Programmable Controllers – Part 3 Programming Languages
- E. Institute of Electrical and Electronic Engineers (IEEE)
 - 1. IEEE Standard C2 – National Electrical Safety Code (NESEC)
 - 2. IEEE Standard 472 - Electrical Surge Protection
 - 3. IEEE Standard 802.X – LAN/MAN Standards
- F. Electronic Industries Alliance (EIA)
 - 1. EIA Standard RS-232-C – Interface between data terminal equipment and data communication equipment employing serial binary data interchange.
 - 2. EIA Standard RS-422-A – Electrical characteristics of balanced voltage digital interface circuits
- G. Instrumentation, Systems, and Automation Society (ISA)
 - 1. ISA S5.2 – Binary Logic Diagrams for Process Operations
 - 2. ISA S5.3 – Graphic Symbols for Distributed Control/Shared Display Instrumentation Logic and Computer Systems.
 - 3. ISA S5.4 – Instrument Loop Diagrams
 - 4. ISA S20 – Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - 5. ISA RP60.3 – Human Engineering for Control Centers
 - 6. ISA RP60.6 – Nameplates, Labels, and Tags for Control Centers
- H. National Fire Protection Agency (NFPA)
 - 1. NFPA 70 – National Electrical Code.
- I. National Electrical Manufacturers Associations (NEMA)
 - 1. NEMA ICS6 – Enclosures for Industrial Controls and Systems
- J. Underwriters Laboratories, Inc. (UL)
 - 1. UL 508 – Industrial Control Equipment

1.05 QUALITY ASSURANCE

- A. The PCSI shall be a "systems house" regularly engaged in the design and the installation of instrumentation systems and their associated subsystems as they are applied to the municipal water and wastewater industry. For the purposes of this Specification Section, a "systems house" shall be interpreted to mean an organization that complies with all of the following criteria:
1. Employs a professional Control Systems Engineer or Electrical Engineer registered in the State of California to supervise or perform the work required by this Specification Section.
 2. Employs personnel on this project who have successfully completed ISA or manufacturers' training courses on general process instrumentation and configuration and implementation of the specific process controllers, computers, and software proposed for this project.
 3. Has performed work of similar or greater complexity on at least five previous projects.
 4. Has been actively engaged in the type of work specified in this Specification Section for a minimum of five years.
 5. Has been actively engaged in industrial process control programming and system integration for a minimum of ten years.
 6. Has been actively engaged in PLC programming, HMI configuration and system integration for a minimum of five years.
- B. The PCSI shall maintain a permanent, fully staffed and equipped service facility within 4 hours travel time of the project site with full time employees capable of designing, fabricating, installing, calibrating, and testing the systems specified herein. At a minimum, the PCSI shall be capable of responding to on-site problems within 12 hours of notice.
- C. Actual installation of the instrumentation system need not be performed by the PCSI's employees; however, the PCSI as a minimum shall be responsible for the technical supervision of the installation by providing on site supervision to the installers of the various components.
- D. The PCSI shall furnish equipment that is the product of one manufacturer to the maximum practical extent. Where this is not practical, all equipment of a given type shall be the product of one manufacturer.
- E. The PCSI shall be one of the following (listed in alphabetical order), or equal, as approved by the City:
1. KBL Associates, Hayward, California
 2. MCC Controls, Vacaville, California
 3. Tesco Controls Inc, Sacramento, California
 4. Wunderlich-Malec, Pleasanton, California

1.06 SYSTEM DESCRIPTION

- A. The station HMI system shall monitor and control the installed equipment via a PLC system configured to operate as a standalone facility.

1.07 DELIVERY, STORAGE AND HANDLING

A. Shipping Precautions

1. After completion of shop assembly, factory test and approval of all equipment, cabinets, panels and consoles shall be packed in protective crates and enclosed in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust and moisture. Dehumidifiers shall be placed inside the polyethylene coverings. The equipment shall then be skid-mounted for final transport. Lifting rings shall be provided for moving enclosures
2. Without removing protective covering. Boxed weights shall be shown on shipping tags together with instructions for unloading, transporting, storing and handling at the job site.
3. Special instructions for proper field handling, storage and installation required by the manufacturer for proper protection, shall be securely attached to the packaging for each piece of equipment prior to shipment. The instructions shall be stored in resealable plastic bags or other acceptable means of protection.
4. None of the HMI control and monitoring equipment shall be shipped to the site until the designated control room and/or process areas are environmentally stable and suitable for the equipment. The Contractor and PCSI shall accept the equipment on delivery and supervise unloading within the control room areas.
5. All equipment furnished under related Specification Sections of Division 13 shall be shipped to the job site via dedicated air ride van.

B. Shipping Coordination

1. Coordinate shipping and installation of panel with phased construction sequence, installation of new process units, and construction of new facilities as specified in the Contract Documents.

C. Identification During Shipping and Storage

1. Each component shall be tagged to identify its location, tag number and function in the system. Identification shall be prominently displayed on the outside of the package.

D. Storage

1. Equipment shall not be stored out-of-doors. Equipment shall be stored in dry permanent shelters including in-line equipment and shall be adequately protected against mechanical damage. Equipment stored in untreated spaces shall have condensation space heaters installed to prevent moisture condensing on or within the equipment. Provide suitable power source for space heaters as required.
2. If any apparatus has been damaged, such damage shall be repaired by the PCSI at his/her own cost and expense. If any apparatus has been subject to possible injury by water, it shall be thoroughly dried out and put through such tests as directed by Engineer. This shall be at the cost and expense of the PCSI, or the apparatus shall be replaced by the PCSI at no additional cost.

1.08 PROJECT/SITE REQUIREMENTS

- A. Elevation: Equipment shall be designed to operate at a ground elevation of approximately 50 feet above mean sea level.

- B. Temperature:
 - 1. Equipment shall be suitable for operation and storage at temperatures from 0° to +40° C degrees ambient.
- C. Relative Humidity. Air conditioned area equipment shall be suitable for 20 to 95 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.
- D. Power Supply: 120 volts AC sources of electrical power supply shall be from unregulated industrial panel boards (either utility or standby generator) unless a UPS power source is indicated on the Drawings.

1.09 MAINTENANCE

- A. Test Equipment
 - 1. Additional test equipment as defined in the related technical Specification Sections of Division 13.
- B. Spare Parts
 - 1. Provide spare parts of the type and quantity as specified herein and as specified in the related technical specifications of Division 13.
 - 2. All spare parts shall be carefully packed in cartons, labeled with indelible markings, and shall be adequately treated for a long period of storage. Complete ordering information including manufacturer's part number, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by City.
 - 3. In addition to the spare parts specified under the related technical specifications of Division 13, provide the following:
 - a. Fuses - 10% (minimum of 5) of each type and size provided
 - b. Lamps and LEDs - 5% (minimum of 2) of each type provided
 - c. One power supply of each type provided.
 - d. Six of each type cable connector provided.
- C. There are two water quality sample streams that will have the following instruments a specified herein and shown on the Drawings:
 - 1. Free chlorine: free chlorine that will operate over the following pH range: 7 to 9
 - 2. Total chlorine: Pre-Blending: pH, temperature, and total chlorine, that will operate over the following pH range: 7 to 9
 - 3. Each of the two sets of instruments shall be panel mounted, for a total of two panels. Each panel shall be configured for one flow thru sample supply line coming in, and one drain line out of each panel.
- D. Reagents
 - 1. Analyzers' equipment and layout are designed around first named equipment supplier. The purpose of the design is to minimize reagent use. The only reagent associated with first named suppliers' scope is a vinegar-based reagent (5% Acetic Acid - .0055 Potassium Iodide Solution) whose MSDS Hazards Identification are as follows: Health Rating:1; Flammability Rating: 0; Reactivity

Rating: 0, and Contact Rating: 1. This reagent is not an anticipated or known carcinogen.

2. Manufacturer's not named in these specifications shall submit evidence in the form of MSDS Hazard sheets that their reagents are of similar quality and volume (5 gallons over 60 days) to be considered an as-equal.

1.10 COORDINATION WORKSHOPS

- A. The PCSI shall schedule and hold two mandatory control system Coordination Workshops during the Project. The Coordination Workshops shall include as a minimum the City, the Engineer, the Contractor, the PCSI's Project engineer, and electrical subcontractor. The City shall determine which staff members will attend each workshop. Workshops shall all be held at a location in the City to be determined.
- B. Schedule the Coordination Workshops a minimum of two weeks prior to the workshop date and include a draft agenda at the time of the request for review. Within one week subsequent to each workshop, submit draft workshop minutes for review and comment; submit final minutes incorporating any comments as necessary. The PCSI shall be responsible for facilitating the workshop and providing presentation material to all participants. The PCSI and Contractor shall document the proceedings of the Coordination Workshops and submit along with all materials used at the workshop.
- C. Workshops
 1. Overall System Workshop:
 2. A minimum of two weeks prior to any submittals being sent in for review PCSI shall lead and facilitate a 4-hour workshop to review preliminary submittals & schedules. The preliminary submittals should include the following:
 - a. Identify all equipment and instrumentation along with manufacturer & part/model numbers for each of the items.
 - b. Identify any long lead items with submittals that need to be prepared expeditiously.
 - c. Review overall Contractor's schedule and identify how the PCSI schedule has been integrated into it. As specified, the PCSI schedule shall include all major milestones including submittals, field fabrication, testing, installation, field testing & training.
 - d. Programming approach
 - 1) Present sample draft HMI screens
 - 2) Present samples of screen navigation and the use of pop-up windows.
 - 3) Present tagging conventions to be used in HMI & PLC programs.
 - 4) Present a list of screens to be developed under this Contract.
 - 5) Present proposed documentation for PLC programming including functional rung or flow chart documentation, page documentation, etc. all as specified herein.
 - 6) Present proposed documentation for HMI programming documentation including database addressing, scripts, etc. all as specified herein.

- e. The PCSI shall use the P&IDs and Control Descriptions in Section 13415 to demonstrate their understanding of and methods for the system programming.
 - f. Identify any data needs required from the City including additional autodialer alarm conditions and telephone numbers.
3. Project On-Site Testing, Training, Startup & Commissioning Workshop: Following successful completion of the PCSI Factory Testing but prior to startup of the main control panel, PCSI shall conduct a four (4) hour workshop. The intent of this workshop is for the PCSI and Contractor to provide a review of the project schedule and project execution regarding testing, startup, and training as follows:
- a. On Site Testing: Summarize the schedule for each stage of field testing and identify the teams that will be responsible for the testing. The PCSI and Contractor shall prepare a summary of how all the testing will be performed, documented, and submitted. Draft test forms as specified herein shall be presented at the workshop.
 - b. Training: The PCSI and Contractor shall provide a listing of all the scheduled training that will take place with anticipated dates in accordance with these Specifications. The PCSI and Contractor shall also prepare a summary of personnel and qualifications of the individuals responsible for the training. Also indicate the target audience for the training. Any off-site training should be coordinated with the City staff at least 30 days prior to training.
 - c. Startup: The PCSI and Contractor shall coordinate startup and integrate into the startup plan. The PCSI and Contractor shall provide the draft startup plan including schedule for the startup and the personnel responsible for the startup. The plan shall be reviewed by and coordinated with the City operations, technical, and engineering staff to accommodate City operational requirements. The PCSI and Contractor shall be responsible for the preparation of all documentation that will be used for the startup testing and verification as specified herein.
 - d. Commissioning: Contractor shall review the Commissioning plan and provide status of required deliverables including but not limited to:
 - 1) O & M's
 - 2) Spare Parts
 - 3) Warranties
 - 4) Service Agreements
 - 5) Special equipment and tools

1.11 FINAL SYSTEM DOCUMENTATION

- A. Submit operation and maintenance manuals covering instruction and maintenance on each type of equipment in accordance with the Section 01782. The PCSI shall provide operation and maintenance manuals in both hard-copy printed versions and electronic versions. Electronic files shall be provided in searchable Adobe Acrobat (.pdf) format. As-built drawings shall be provided in AutoCAD format.
- B. The instructions shall be bound in three-ring binders with drawings reduced or folded for inclusion and shall provide at least the following as a minimum.

1. A comprehensive index.
 2. A complete "As Built" set of the PCSI approved hardware, software, and panel fabrication shop drawings.
 3. A complete list and data sheets of the equipment supplied, including serial numbers, ranges and pertinent data.
 4. Full specifications on each item.
 5. System schematic drawings "As Built" and "As-Left" details illustrating all components and final condition of each.
 6. Detailed service, maintenance and operation instructions for each item supplied.
 7. Special maintenance requirements particular to these systems shall be clearly defined, along with special calibration and test procedures.
 8. The operation instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
 9. Complete parts lists with stock numbers and name, address and telephone number of the local Supplier.
- C. The PCSI's final documentation shall be new documentation written specifically for this project, but may include annotated standard documentation. All standard documentation furnished shall have all portions that apply clearly indicated. All portions that do not apply shall be lined out.
- D. The manuals shall contain all illustrations, detailed drawings, electrical schematics and instructions necessary for installing, operating and maintaining the equipment. The illustrated parts shall be numbered for identification. All information contained therein shall apply specifically to the equipment furnished and shall only include instructions that are applicable. All such figures shall be formatted within the printing of the page to form a legible, durable, and permanent reference book.
- E. Submit original software CD-ROMs, or data packs of all software provided under this Contract. Submit original paper based or electronic documentation of all software provided. Submit license agreement information including serial numbers, license agreements, User Registration Numbers, etc. All software provided under this Contract shall be licensed to the City.
- F. The requirements for the PCSI's final documentation are as follows:
1. As built documentation shall include information from submittals, as described in this Specification, updated to reflect the as-built system. Any errors in or modifications to the system resulting from the Factory and/or Functional Acceptance Tests shall be incorporated in this documentation.
 2. The Hardware Maintenance Documentation shall describe the detailed preventive and corrective procedures required to keep the system in good operating condition. Within the complete Hardware Maintenance Documentation, all hardware maintenance manuals shall make reference to appropriate diagnostics, where applicable, and all necessary timing diagrams shall be included. A maintenance manual or a set of manuals shall be furnished for all delivered hardware, including peripherals. The Hardware Maintenance Documentation shall include, as a minimum, the following information:

- a. Operation Information - include a detailed description of how the equipment operates and a block diagram illustrating each major assembly in the equipment.
 - b. Preventative-Maintenance Instructions – These instructions shall include all applicable visual examinations, hardware testing and diagnostic routines and the adjustments necessary for periodic preventive maintenance of the System.
 - c. Corrective-Maintenance Instructions – Include guides for locating malfunctions down to the card-replacement level. These guides shall include adequate details for quickly and efficiently locating the cause of an equipment malfunction and shall state the probable source(s) of trouble, the symptoms, probable cause and instructions for remedying the malfunction.
 - d. Parts Information – Include the identification of each replaceable or field-repairable module. All parts shall be identified on a list in a drawing; the identification shall be of a level of detail sufficient for procuring any repairable or replaceable part. Cross-references between the PCSI's part number and manufacturer's part numbers shall be provided.
 - e. Manufacturer's contact information including name, local representative, phone numbers, web sites, and e-mail contact information.
3. The Software Maintenance documentation shall provide a detailed description of the entire software system. This documentation shall be sufficient for software maintenance and modification of the entire software system. The following items shall be included with the software maintenance documentation:
- a. System PCSI's User Manuals - All applicable software manuals developed by the PCSI for the application software.
 - b. Application/Custom Software Manuals - All software maintenance information not included in the system supplier's standard manuals. Each custom program developed specifically for the system shall include the following information as a minimum:
 - 1) Table of Contents
 - 2) Overview of the program
 - 3) Narrative describing specifically how the program works. All calculations, references to process I/O points and operator inputs should be mentioned and cross referenced to the logic diagrams or code.
 - c. Software Listings and Databases- Submit copies of well-annotated as-built program listings of all software developed under this Contract. Listings shall reflect the as-built condition of the logic development submitted as part of the shop drawing review process. Listings shall include, but not be limited to, the following:
 - 1) All listings associated with the system generation and software configuration (e.g., system parameterization tables, build maps, disk maps, etc). Submittals shall be included for process controllers, HMI application software, database applications, and all other equipment where specific programs or scripts were developed for this project.

- 2) Listings of all data bases configured for and associated with the system.
 - 3) Listing of all custom or modified software developed specifically for the system. Listings shall reflect any changes made after the factory acceptance test.
 - d. Machine Readable Documentation - The supplier shall provide two sets of as-built documentation on CD-ROMs or other approved machine readable format for all programs developed under this Contract. The machine readable documentation shall be 100 percent compatible with the Software Listings previous defined and include all documentation files including logic and annotation files. Any changes made during or after factory acceptance test shall be incorporated.
 - e. Program and Configuration Files – The PCSI shall provide two sets of as-built program and configuration files in electronic format on CD-ROMs. Programs shall be provided in their native format and include logic, configuration, as-built setpoints and register values. Program and configuration files shall be provided for all programmable or configurable electronic devices provided by the PCSI. Programs and/or portions of programs shall not be password protected in any way that would prevent future modifications by the City.
4. Provide Operator's Manuals for the system operators. These manuals shall be separately bound and shall contain all information necessary for the operator to operate the system. The manuals shall be written in non-technical terms and shall be organized for quick access to each detailed description of the operator's procedure. Manuals shall contain, but not be limited to, the following information:
- a. A simple overview of the entire system indicating the function and purpose of each piece of equipment.
 - b. A detailed description of the operation of the HMI and Local Operator Panels including all appropriate displays, diagnostic screens, operating system, etc.
 - c. A detailed operational description of all control panels provided.
 - d. Step-by-step procedures for starting up or shutting down an individual component.
 - e. Step-by-step procedures for starting up and shutting down the entire system.
 - f. A comprehensive description of the operation and control of each process. All operator actions to these processes and the associated reaction described.
 - g. Operational description for operating HMI computer equipment and peripherals. Description shall include procedures for typical maintenance and troubleshooting tasks.
 - h. A listing of all data base point names with their respective English language point descriptions, memory address, and HMI graphic screen cross reference where the points can be found.
 - i. A complete glossary of terms.

- j. Complete, step-by-step procedures for performing complete system or selected file backup and restoration.

1.12 CODES, INSPECTION AND FEES

- A. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction.
- B. Obtain all necessary permits and pay all fees required for permits and inspections.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. General

1. Substitutions on functions or type of equipment specified will not be acceptable unless specifically noted. In order to insure the interchangeability of parts, the maintenance of quality, the ease of interfacing between the various subsystems and the establishment of minimums with regard to ranges and accuracy, strict compliance with the above requirements shall be maintained. In order to insure compatibility between all equipment, it shall be the responsibility of the PCSI to coordinate all interface requirements with mechanical and electrical systems and furnish any signal isolation devices that might be required.
2. To facilitate the City's future operation and maintenance, products shall be of the same major instrumentation manufacturer, with panel mounted devices of the same type and model as far as possible.

B. Physical

1. All instrumentation supplied shall be of the manufacturer's latest design and shall produce or be activated by signals that are established standards for the water industry.
2. Wetted components of the instrument for each installation shall be made of materials that are abrasion-resistant and corrosion-resistant to the process (e.g. raw sewage, hypochlorite) as shown on the Drawings and as appropriate for the installation. The wetted components material(s) shall exhibit excellent or good abrasion and corrosion resistance to the chemical in service as rated by the material manufacturer. The final approval of material selection shall rest with the Engineer.
3. All electronic instrumentation shall be of the solid-state type and shall utilize either linear transmission signals of isolated 4 to 20 mA dc (milliampere direct current) or digital protocol where specified.
4. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission. No zero based signals will be allowed.
5. Provide mounting hardware and floor stands, wall brackets, or instrument racks. Fasteners for securing control panels and enclosures to walls and floors shall be either hot-dipped galvanized after fabrication or stainless steel. Provide stainless steel fasteners only in corrosive areas rated NEMA 4X. Provide and size anchors in accordance with section 01190 as required per the seismic calculations. Provide minimum size anchor of 3/8-inch.
6. All indicators shall be linear in engineering process units unless otherwise noted.

7. All transmitters shall be provided with either integral indicators or conduit mounted indicators in process units, accurate to two percent or better.
8. Electronic equipment shall be of the manufacturer's latest design, utilizing printed circuitry and suitably coated to prevent contamination by dust, moisture and fungus. Solid state components shall be conservatively rated for their purpose, to assure optimum long term performance and dependability over ambient atmosphere fluctuations and 0 to 100 percent relative humidity. The field mounted equipment and system components shall be designed for installation in dusty, humid and slightly corrosive service conditions.
9. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, and shall consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.
10. All electronic/digital equipment shall be provided with radio frequency interference protection.
11. Provide heating, cooling, dehumidifying, and filtering devices in control panel, enclosures, and cabinets as required to maintain internal ambient conditions within the most restrictive requirements of the equipment housed. Submit calculations as part of the panel fabrication submittal process verifying these requirements.

C. Electrical

1. Equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided between power supply and interconnected instrument loop or fieldbus link. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
2. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials are available.
3. Equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting when power is restored unless otherwise noted.
4. All transmitter output signals shall include signal and power source isolation.

D. Nameplates

1. General: Provide nameplates as specified below unless specified otherwise in the detailed technical Specifications of related Sections of Division 13.
2. All panels and field instruments shall be supplied with suitable nameplates that identify the panel and individual devices as required.
3. Nameplates shall be a 3/32-inch thick, black and white, laminated Bakelite or Lamecoid with engraved inscriptions. The letters shall be white against a black background. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.
4. Orient nameplates to facilitate reading the device identifier from a cursory inspection. Do not mount nameplates behind or under equipment.

5. Nameplate fasteners and mounting shall be:
 - a. Stainless steel wire, 0.048-inch diameter with stainless steel crimped clamps for hanging nameplates.
 - b. Stainless steel screws for cabinet mounted nameplates
6. Nameplates shall be as recommended by ISA Recommended Practice RP60.6.

2.02 LIGHTNING/SURGE PROTECTION

- A. General – Lightning/Surge protection shall be provided to protect the electronic instrumentation system from induced surges propagating along the signal and power supply lines from lightning, utility, or the internal electrical distribution system. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level. Protection shall be maintenance free and self-restoring.
- B. Field Instrumentation Protection – Provide individual device protection for each field instrument mounted outside of the building or facility housing the control panel. Instruments mounted within the structure as the associated control panel shall not require surge protection. Instruments shall be housed in a suitable metallic case, properly grounded. Ground wires for all instrumentation device surge protectors shall be connected to a good earth ground. Where practical route each ground wire individually and insulated from each other. Device surge protectors shall be mounted within the instrument enclosure or a separate junction box coupled to the enclosure. Provide surge protection devices as manufactured by Phoenix Contact, Telecommunications Industries Inc.; or approved equal.
- C. Control Panel Power Supply – Provide protection of all 120 VAC instrument power supply lines. Source voltage to cabinets/panels regardless of location (indoor or outdoor), shall be protected by surge suppressors. Provide gas tube surge suppressors or metal oxide varistors (MOVs) located at the point where the 120V source supply enters the enclosure. Install the surge device to be in strict compliance with the manufacturer's recommendation for maximum allowable circuit length between protective device and incoming circuit. Provide signal surge suppression devices as manufactured by Phoenix Contact or approved equal.
- D. Instrument 120 V Power Supply – Provide protection for 120 VAC power to all 4-wire field instruments (indoor or outdoor). Provide individual gas tube surge suppressors or metal oxide varistors (MOVs) located at the instrument end of the circuit. Provide signal surge suppression devices as manufactured by Phoenix Contact or approved equal.
- E. 4-20 mA Signal Lines and Non-Fiber Based Data Highway Circuits – Provide protection on all signal and data highway circuits that leave a building or are routed external to a building. Provide gas tube surge arrestors, and Zener diode protectors. Circuit protection shall be provided at both ends of the signal or data highway lines within the control panel at one end and as close to the instruments or termination device as possible. Provide signal surge suppression devices as manufactured by Phoenix Contact or approved equal.
- F. Inductive Loads – Provide interposing relays on all process controller outputs or switches rated 100 VA or less that drive solenoid, coil, or motor loads. Refer to the detailed requirements for controller output protection in the detailed technical Specifications of the related Sections of Division 13. Provide interposing relays as manufactured by Phoenix Contact or approved equal.

2.03 TUBING AND FITTINGS (NOT USED)

2.04 PROCESS INSTRUMENT SEALS

- A. Provide diaphragm seals and annular seals where shown on the Drawings or where the instrument wetted parts are not chemically compatible with the process fluid being measured.
 - 1. Provide isolation valve between seal and process to allow isolation and replacement of the seal and instrument.
 - 2. Diaphragm Seal - Threaded
 - a. Type:
 - 1) Thread attached.
 - 2) Welded Metal Diaphragm.
 - b. Function/Performance:
 - 1) Maximum Pressure: Two times the maximum process pressure.
 - 2) Operating Temperature: -40 to 100° C.
 - c. Physical:
 - 1) All 316L stainless steel construction.
 - 2) Teflon gaskets and O rings on process connection.
 - 3) Filling screw and bleeding connection provided.
 - d. Accessories Required:
 - 1) Stainless steel armored capillary tubing as required for the installation.
 - e. Manufacturer(s):
 - 1) Rosemount.
 - 2) Ashcroft.
 - 3) Ronningen-Petter Company.
 - 4) Or equal.

2.05 PANEL MARKINGS

- A. Each control panel shall be manufactured and assembled per the requirements of UL 508A. The complete assembly shall bear the UL label as an Industrial Control Panel as defined by UL 508A. If required for UL labeling, provide ground fault protective devices, isolation transformers, fuses and other equipment as necessary to achieve compliance with the UL standard. The Drawings do not detail all UL requirements.
- B. The UL label requirements shall apply to all panels except where enclosures contain instruments mounted through the enclosure walls or doors. In this case, panel construction shall meet all requirements of UL labeling as described above, but no UL label is required. This exception applies only if UL Recognized instruments or devices for the intended purpose are not made.

2.06 CHLORINE RESIDUAL ANALYZER (AMPEROMETRIC TYPE)

- A. Type:

1. Microprocessor based electronic transmitter/converter with a flow through sample cell.
 2. Provide sensors to measure free and total chlorine, pH, and temperature. Analyzer to be configured for free and total chlorine as indicated on the Drawings and the Instrument Device Schedule.
 3. Utilizes amperometric methods.
- B. Function/Performance:
1. Range: 0-20 ppm for free and total Chlorine, 0-14 pH, and 32-122° F.
 2. Environmental Conditions: The instrument shall operate over an ambient temperature range of 0-45 °C.
 3. Outputs: Four (4) isolated 4-20 mA outputs for free chlorine, total chlorine, pH, and temperature. Eight (8) configurable alarm contacts rated 5 A at 230 VAC, adjustable to trip at any point in the instrument range.
 4. Display: 240x64 pixel graphic display with 9-key keypad for configuration.
 5. pH and Temperature Compensation: The analyzers shall incorporate pH and temperature compensation to maintain the instruments accuracy for sample flows between 6.0 and 8.5 pH, and between 55 and 85° F.
 6. Flow through sample cell shall include flow control to maintain the instruments required sample flow at inlet pressures of between 7 and 60 PSI.
 7. Diagnostics: On screen instructions and self diagnostics.
 8. Total Chlorine:
 - a. Low Limit Of Detection (LOD): 0.03 ppm or better.
 - b. Repeatability/precision: 0.03 ppm or 3%, whichever is greater.
 - c. Response time: 90% of full scale within 120 seconds
 9. Free Chlorine:
 - a. Low Limit Of Detection (LOD): 0.03 ppm or better.
 - b. Repeatability/precision: 0.03 ppm 3%, whichever is greater.
 - c. Response time: 90% of full scale within 30 seconds.
- C. Physical:
1. Analyzers shall be suitable for surface mounting.
 2. A/C power will be as specified in Section 13410.
 3. Electronics enclosure shall be NEMA 4X.
- D. Accessories Required:
1. One year supply of consumables
 2. One spare electrode of each type.
- E. Manufacturer(s):
1. Emerson Process Controls/Rosemount Analytical Model FCL-01-241
 2. Approved equal.

2.07 TOTAL CHLORINE ANALYZER

A. Type:

1. Microprocessor based electronic transmitter/converter with a flow through sample cell.
2. Provide sensors to measure total chlorine, pH, and temperature. Analyzer to be configured for total chlorine as indicated on the Drawings and the Instrument Schedule.
3. Utilizes amperometric methods.

B. Function/Performance:

1. Range: 0-20 ppm total Chlorine, 0-14 pH, and 32-122° F.
2. Environmental Conditions: The instrument shall operate over an ambient temperature range of 0-45 °C.
3. Outputs: Four (4) isolated 4-20 mA outputs for total chlorine, pH, and temperature. Eight (8) configurable alarm contacts rated 5 A at 230 VAC, adjustable to trip at any point in the instrument range.
4. Display: Programmable four line, back lit display.
5. pH and Temperature Compensation: The analyzers shall incorporate pH and temperature compensation to maintain the instruments accuracy for sample flows between 6.0 and 8.5 pH, and between 55 and 85° F.
6. Flow through sample cell shall include flow control to maintain the instruments required sample flow at inlet pressures of between 7 and 60 PSI.
7. Diagnostics: On screen instructions and self diagnostics.
8. Total Chlorine:
 - a. Low Limit Of Detection (LOD): 0.03 ppm or better.
 - b. Repeatability/precision: 0.03 ppm or 3%, whichever is greater.
 - c. Response time: 90% of full scale within 120 seconds.

C. Physical:

1. Analyzers shall be suitable for surface mounting.
2. A/C power will be as specified in Section 13410.
3. Electronics enclosure shall be NEMA 4X.

D. Accessories Required:

1. One year supply of consumables
2. One spare electrode.

E. Manufacturer(s):

1. Emerson Process Controls/Rosemount Analytical Model TCL-11-280
2. Approved equal.

2.08 PH/TEMPERATURE ANALYZER

A. Type:

1. pH-sensitive bare electrode sensor with Pt 1000 temperature sensor.
2. Microprocessor based electronic transmitter/converter with a flow through sample cell.

B. Function/Performance:

1. Range: 0-14 pH and 32-122° F.
2. Environmental Conditions: The instrument shall operate over an ambient temperature range of 0-45 °C.
3. Outputs: Four (4) isolated 4-20 mA outputs for pH and temperature. Eight (8) configurable alarm contacts rated 5 A at 230 VAC, adjustable to trip at any point in the instrument range.
4. Display: high resolution color LCD.
5. Flow through sample cell shall include flow control to maintain the instruments required sample flow at inlet pressures of between 7 and 60 PSI.
6. Diagnostics: On screen instructions and self diagnostics.

C. Physical:

1. Analyzers shall be suitable for surface mounting.
2. A/C power will be as specified in Section 13410.
3. Electronics enclosure shall be NEMA 4X.

D. Accessories Required:

1. Provide one year supply of consumables and one spare electrode of each type.
2. One accessory set, including cable unions, cable bushings, and fuses.
3. One MFC motherboard

E. Manufacturer(s):

1. Emerson Process Controls/Rosemount Analytical 3900 Sensor with Model 56 Analyzer
2. Approved equal.

2.09 MAGNETIC FLOWMETER

A. Flow Element (FE)

1. Type
 - a. Pulsed DC type.
2. Function/Performance
 - a. Operating Temperature: Process liquid temperatures of –10 to 70° C and an ambient of –10 to 60° C.
 - b. Range: As required by the Field Instrument List, Appendix 13410-B.
 - c. RFI protection: RFI protection to be provided.
 - d. Pressure rating: Equal to or greater than piping system where meter is installed.

- e. Additional: Meter shall be capable of running empty indefinitely without damage to any component.
3. Physical
- a. Metering Tube: Carbon steel with two-part corrosion-resistant epoxy coating or as recommended by the manufacturer for application.
 - b. Flanges: ANSI 150 lb. or as required by the piping system, unless otherwise indicated.
 - c. Liner: EPDM for drinking water processes, PTFE for chemical processes, or as otherwise recommended by the manufacturer for application.
 - d. Electrodes: Hastelloy C or as otherwise recommended by the manufacturer for application.
 - e. Housing: Meters below grade shall be suitable for submergence for up to 48 hours to a depth of 30 ft (9m). Meters above grade shall be NEMA 4X (IP65). Where hazardous areas are indicated on the Drawings, the equipment shall be rated for that area. Meters not suitable for direct sunlight shall have sunshield installed as required.
 - f. Finish: All external surfaces shall have a chemical and corrosion resistant finish.
4. Accessories/Documentation Required
- a. Factory calibration: All meters shall be factory calibrated. A copy of the report shall be included in the O&M manual.
 - b. Certification: Flow meters directly involved in drinking water processes shall be NSF/ANSI 61 certified.
 - c. Grounding: Meter shall be grounded in accordance with the manufacturer's recommendation. Provide ground ring, ground wires, gaskets, etc., as required. All materials shall be suitable for the liquid being measured.
 - d. Signal cable for installation between the flowtube and the transmitter. Length shall be as field verified and as required by installation indicated on the Drawings. Connector cable length shall be provided as a continuous length dictated by field conditions. Splicing of cable shall not be allowed.
5. Manufacturer(s)
- a. Siemens Mag 3100 and/or 5100W (chemical and/or water).
 - b. Or equal
- B. Flow Indicating Transmitter (FIT)
1. Type
- a. Micro processor based, intelligent transmitter compatible with flowtube provided.
 - b. Integral or remote mounted as shown on the Drawings.
 - c. FIT shall be of same manufacturer as FE.
2. Functional/Performance
- a. Accuracy (including flowtube): Plus/minus 0.5 percent of flowrate.

- b. Operating Temperature: -10 to 50 DegC.
 - c. Output: Isolated 4-20 mA with HART protocol. Current output adjustable over the full range of the instrument.
 - d. Diagnostics: Self diagnostics with on screen display of faults.
 - e. Display: Digital indicator displaying flow in engineering units indicated in the Instrument Schedule.
 - f. Totalizer: A fully configurable totalizer integral to the transmitter. Totalized flow shall be displayed.
 - g. Empty Tube Zero: The transmitter shall include a feature that will lock the output at zero when no flow is detected. The empty tube zero feature shall be enabled automatically when the transmitter detects no flow or manually through a contact input.
3. Physical
- a. Transmitter shall be suitable for integral, surface, or pipe stand mounting as required.
 - b. Transmitters not suitable for direct sunlight shall have a sunshield installed as required.
 - c. Enclosure shall be NEMA 4X (IP65)
 - d. Input Power: 120VAC
4. Accessories/ Required
- a. Keypad where required for transmitter configuration.
5. Manufacturer(s)
- a. Siemens SITRANS F M MAG 5000.
 - b. Or equal

2.10 GAUGE PRESSURE OR LEVEL TRANSMITTERS

A. Type

- 1. Microprocessor based, intelligent type.

B. Function/Performance:

- 1. Range: Range of the transmitter shall be the standard range of the manufacturer closest to the pressure range to be metered.
- 2. Accuracy: 0.04 percent of span.
- 3. Operating Temperature: -20 to 80° C.
- 4. Temperature Effect: Combined temperature effects shall be less than 0.2 percent of maximum span per 28° C temperature change.
- 5. Output: 4-20 mA DC linear with pressure or level, with HART protocol. Zero adjustable over the range of the instrument provided calibrated span is greater than the minimum calibrated span.
- 6. Stability: 0.2 percent of upper range limit for 1 year.
- 7. Display: Digital indicator displaying pressure or level in the engineering units indicated in the Instrument Device Schedule.

8. Diagnostics: Self diagnostics with transmitter failure driving output to above or below out of range limits.
9. Over Range Protection: Provide positive over range protection to 150% of the maximum pressure of the system being monitored by the instrument.
10. If required to meet the range or suppression/elevation requirements, a differential pressure transmitter shall be provided.

C. Physical

1. Enclosure: NEMA 4X (IP66), explosion proof, approved for Class I, Division 1, Groups C and D (EEx d IIC T5).
2. Process Wetted Parts: Isolating diaphragm and other wetted metal parts shall be 316L stainless steel, or as recommended by the manufacturer for the specific process fluid. Contractor shall confirm compatibility with the process fluid for each transmitter. Gaskets and O rings shall be Teflon.
3. Power Supply: 24 VDC loop power.
4. Sensor Fill Fluid: Silicone.

D. Accessories Required

1. Provide span and zero adjustment at each transmitter and through the handheld programming unit.
2. For each transmitter provide three valve manifold. The manifold shall be 316 stainless steel. Manifolds may be mounted directly to the instrument or separately mounted. Manifolds shall be by the instrument manufacturer or by D/A Manufacturing or Anderson Greenwood.
3. Provide mounting accessories necessary

E. Manufacturer(s)

1. Rosemount 3051CG
2. ABB
3. Endress & Hauser
4. Or equal

2.11 ELECTRODE RELAY LEVEL SWITCH

A. Type:

1. Conducting electrodes that actuate a solid state relay (level switch) at a given liquid level.

B. Physical:

1. Electrodes shall be Hastelloy C rod type as indicated on the Drawings or in the Instrument Device Schedule. Electrodes shall be Teflon sheathed for corrosive substance service. Cables for wire suspended electrodes shall be PVC jacketed for non-corrosive applications, and Teflon jacketed for corrosive applications.
2. Electrode holder shall be PVC with a watertight cover, mounted 3 inch (80 mm). Flanges shall be CPVC for sodium hypochlorite applications and PVC for others. Number and type of electrode openings shall be as required.

- C. Manufacturer(s):
 - 1. Gems (Warrick) Sensors.
 - 2. Ametek (B/W Controls.)
 - 3. Approved equal.
- D. Level Switch Relay
 - 1. Type:
 - a. Solid state relay.
 - 2. Function/Performance:
 - a. DPDT contacts for each level switch indicated on the Drawings or in the Instrument Device Schedule. Contacts shall be rated 10 A at 240 VAC.
 - 3. Physical:
 - a. Solid state relays and auxiliary controls shall be mounted as shown on the Drawings in the 20-CP-100 Control Panel.
 - 4. Manufacturer(s):
 - a. Gems (Warrick) Sensors.
 - b. Ametek (B/W Controls).
 - c. Approved equal.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

- A. Equipment shall be installed in accordance with the manufacturer's instructions. The locations of equipment, transmitters, alarms and similar devices are diagrammatic only. Exact locations shall be as determined by the PCSI during development and fabrication of systems.
- B. The drawings indicate the intent and not the precise nature of the interconnection between the individual instruments. Exact nature of the final equipment interconnections shall be as determined by the PCSI during development and fabrication of systems.
- C. Where specific installation details are not specified or shown on the Drawings, installation recommendations from the equipment manufacturers or ISA shall be followed as applicable.
- D. The shield on each process instrumentation cable shall be continuous from source to destination and be grounded in accordance with the manufacturer's recommendations or as directed by the Engineer. In no case shall more than one ground point be employed for each shield.
- E. Once installed, remove lifting rings from cabinets/assemblies. Permanent plugs shall be provided for the holes of the same material and color as the cabinet.
- F. All work shall be executed in full accordance with codes and local rulings. Should any work be performed contrary to said rulings, ordinances and regulations, the Contractor shall bear full responsibility for such violations and assume all costs arising therefrom.

- G. Unless specifically shown in the Drawings, direct reading or electrical transmitting instrumentation shall not be mounted on process piping. Instrumentation shall be mounted on instrument racks or stands as detailed on the installation detail drawings. All instrumentation connections shall be provided with shutoff and drain valves. For differential pressure transmitters, valve manifolds for calibration, testing and blowdown service shall also be provided. For slurries, chemical or corrosive fluids, diaphragm seals with flushing connections shall be provided.
- H. All piping and tubing to and from field instrumentation shall be provided with necessary unions, calibrations and test tees, couplings, adaptors, and shut-off valves. Process tubing shall be installed to slope from the instrument toward process for gas measurement service and from the process toward the instrument for liquid measurement service. Provide drain/vent valves or fittings at any process tubing points where the required slopes cannot be maintained.
- I. Provide local electrical shutoffs and disconnects for all 4-wire field instruments requiring 120 VAC power. Electrical disconnects shall be suitably rated disconnect switches or manual motor starters as specified under Division 16.
- J. Provide all brackets, hangers, and miscellaneous metals required for mounting of equipment. Mounting hardware shall be installed in a workmanlike manner and not interfere with any other equipment.
- K. The PCSI shall provide on-site service to oversee the installation, the placing and location of system components, their connections to the process equipment panels, cabinets and devices, subject to Engineer's approval. The PCSI shall certify that all field wiring for power and signal circuits are correctly done in accordance with best industry practice and provide for all necessary system grounding to insure a satisfactory functioning installation. The PCSI shall schedule and coordinate work under this Section with that of the electrical work specified under applicable Sections of Division 16.
- L. Provide sunshades for equipment mounted outdoors in direct sunlight. Sunshades shall include standoffs to allow air circulation around the cabinet. Orient equipment outdoors to face to the North or as required to minimize the impact of glare on LED, LCD, or other digital readouts.

3.02 TESTING

A. General

1. As part of the requirement of this Specification Section it is the responsibility of the PCSI to provide a complete operational control system. Confirmation of an operational control system is dependent upon results derived from test procedures as specified in this Section.
2. Perform factory testing prior to shipment of the equipment and also testing of the equipment once installed in the field. Once the system is in operation an additional 30-Day Acceptance Test is required.
3. Each test shall be in the cause and effect format. The person conducting the test shall initiate an input (cause) and upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.
4. All tests shall be conducted in accordance with prior Engineer approved procedures, forms and checklist all as submitted by the PCSI under Part 1 of this Specification. Each test to be performed shall be described and a space

provided after it for signoff by the appropriate parties after its satisfactory completion. Include "punchlist" forms with the test procedure to document issues that arise during the testing. Punchlist forms shall include a resolution section that allows a description of the correction and signoff areas for PCSI and Engineer.

5. Copies of the sign off test procedures, forms and checklists will constitute the required test documentation. The test result forms shall be submitted to Engineer for approval at the completion of each test.
6. Provide all necessary testing materials and equipment including multi-meters, simulators, calibrators, tools, jumpers, and personal protective equipment (PPE). All calibration equipment shall have a current NIST calibration certification. Wherever possible, perform tests using actual process variables, equipment, and data. Where it is not practical to test with real process variables, equipment and data, provide suitable means of simulation. Define these simulations techniques in the test procedures.
7. The PCSI shall coordinate all required testing with the Contractor, all affected Subcontractors, the Engineer, and the City.
8. The PCSI shall furnish the services of field service engineers, all special calibration and test equipment and labor to perform the field tests.
9. The Engineer reserves the right to require tests or retests of all specified functions, whether or not explicitly stated on the Test Procedures, as required to determine compliance with the functional requirements of the overall system. Such testing required to determine compliance with the Specified requirements shall be performed at no additional cost to City. Engineer's decision shall be final regarding the acceptability and completeness of all testing.
10. No equipment shall be shipped until City and Engineer have received all test results and approved the system is ready for shipment.

B. Testing Sequence

1. Factory Testing shall be performed at the PCSI fabrication shop facility or at a local facility provided under this Contract within 120 miles of the City's headquarters whichever is closer.
2. Factory Testing shall be performed with all system control panels, HMIs, network equipment, and communication media in place and functional. All system programming shall be completed for PLC control logic, HMI graphic, network addressing (conforming to City addressing requirements) so that the Factory Tests are completed and verify that all system components and elements are operating properly and as specified prior to being shipped to the site.
3. Upon successful completion of the Factory Tests, the PCSI shall coordinate shipping or storage of the system elements as required by the Contractor and as specified to coordinate delivery of control system equipment to the project site.
4. Operational Readiness Test (ORT) and Functional Acceptance Test (FAT) shall be completed on the project control panel, VFDs, motor starters, and all field instrumentation. Successful FAT control system field testing shall be completed prior to any control system operation. Testing shall be scheduled and

coordinated with City staff. Testing shall include 100% checking all remapped and new data points to and from the City central SCADA system.

5. The 30-day Acceptance Test shall apply to the entire control and instrumentation system provided under this contract and shall not commence until all other specified testing has been completed.

C. Factory Testing: Prior to shipment of the equipment the following tests are required:

1. Unwitnessed Factory Test (UFT).

- a. The entire system except for primary elements, final control elements, and field mounted transmitters shall be interconnected and tested to ensure the system will operate as specified. All analog and discrete input/output points not interconnected at this time shall be simulated to ensure proper operation of all alarms, monitoring devices/functions and control devices/functions.
- b. All panels shall be inspected and tested to verify that they are in conformance with related submittals, Specifications and Drawings. During the tests all digital system hardware and software shall be operated for at least five days continuously without a failure to verify the system is capable of continuous operation.
- c. Tests to be performed shall include but not be limited to the following. Each of these tests shall be specifically addressed in the Test Procedure submittal.
 - 1) 100% wiring and database address verification of panel components and process controller I/O as applicable.
 - 2) Demonstrate functionality of the process controls in conformance with the process control loop descriptions. Simulate operating conditions to verify the performance of the monitoring and control functions.
 - 3) Demonstrate graphical user interfaces (hardware and software) for process controllers and HMI.
 - 4) Demonstrate the data communication network, Ethernet, and protocols for transmission and receipt of data on site and to/from remote site locations.
 - 5) Demonstrate all system software functions specified including system heartbeats, clock synchronization, and data export to other application platforms.
 - 6) Test system recovery from failure scenarios including cold boot, warm boot, communication loss, power failure, process failure, redundancy backup systems, etc.
 - 7) Other tests as necessary to verify complete functionality of the entire control system.
- d. Submit summary results of UFT including certified statement of successful completion of all UFT tasks.

2. Witnessed Factory Test (WFT)

- a. Repeat the same series of tests as for the UFT but in the presence of the City and the Engineer. All elements of the WFT shall be witnessed by the City and the Engineer. Provide two weeks schedule notification to the City

and the Engineer prior to performing the WFT. The WFT shall not be held until after favorable review of all hardware, software, and test procedure submittals as specified herein and successful completion of the UFT.

- b. Submit WFT results for review by Engineer.
- D. Field Testing - Following installation of the process control system components and conforming to the testing sequence described above perform the following:
1. Operational Readiness Test (ORT)
 - a. General: Prior to startup and the Functional Acceptance Test, the indicated system elements shall be certified (inspected, wired, calibrated, tested, and documented) that it is installed and ready for the ORT as defined below.
 - b. Loop/Component Inspections and Tests: System shall be checked for proper installation, calibrated and adjusted on a loop-by-loop and component-by-component basis to ensure that it is in conformance with related submittals and these Specifications. PID loop tuning shall be completed as specified herein. Related loops shall be tested as a system to verify interlocks, operations of functionally related loops, etc. all as specified in Section 13415.
 - c. The Loop/Component Inspections and Tests shall be implemented using PCSI developed, Engineer-approved forms and checklists. Each loop of functionally related group of loops (subsystem) shall have a Loop/Subsystem Status Report to organize and track inspection, adjustment and calibration. These reports shall include the following information and checkoff items with spaces for sign off by the system supplier:
 - 1) Project Name, Test Date, PCSI Name, and Lead PCSI Technician Name
 - 2) Loop Number or Loops Numbers of a Tested Subsystem
 - 3) Tag Number for each component.
 - 4) Checkoffs/signoffs for each component:
 - a) Tag/identification (Loop or Subsystem name)
 - b) Installation
 - c) Termination – wiring and tubing
 - d) Scale, Range, and Setpoint as applicable
 - e) Calibration/adjustment (4 point for analog, set point for switches) rising and falling
 - 5) Checkoffs/signoffs for the loop
 - a) Panel interface terminations
 - b) I/O interface terminations
 - c) I/O signal operation
 - d) Inputs/outputs operational: received/sent, processed, adjusted

- e) Total loop operation and operation of subsystem associated loops per Section 13415.
 - 6) Space for comments
 - d. The PCSI shall maintain the Loop Status Reports sheets at the job site and make them available to the Engineer at any time.
 - e. These inspections, calibrations, and tests do not require witnessing. However, Engineer shall review Loop Status Sheets and spot-check the PCSI test process periodically. Any deficiencies found shall be corrected by the PCSI prior to commencement of the Functional Acceptance Test.
 - f. Submit ORT results for review by Engineer.
2. Functional Acceptance Test (FAT).
- a. General: Prior to startup, the installed instrument and control system elements as described above shall be certified that it is ready for operation. A witnessed FAT shall be performed on the system to demonstrate that it is operating and in compliance with these Specifications. All preliminary testing, inspection, and calibration shall be complete as defined in the Operational Readiness Test.
 - b. Each specified function and process control shall be demonstrated on a paragraph-by-paragraph, loop-by-loop, panel-by-panel, and site-by-site basis. FAT shall be correlated to the functional verification of the process control descriptions of Section 13415 addressing specific elements of overall system and sub-system control.
 - c. Loop-specific and non-loop-specific tests shall be the same as specified under Factory Tests except that the system shall be tested and all functions demonstrated using live field based data to the greatest extent possible. In addition, related loops shall be tested as a system to verify interlocks, operations of functionally related loops, etc. all as specified in Section 13415.
 - d. Updated versions of the documentation specified to be provided for during the Factory Tests shall be made available to Engineer at the job site during the tests. In addition, one copy of all O & M Manuals shall be available for reference at the job site during testing.
 - e. Following initial startup, the SCADA control system shall operate for a continuous 100 hours without failure before this test will be started. Network testing and performance testing shall be on-line and monitoring network operation throughout the 100-hour period.
 - f. Punchlist items and resolutions noted during the test shall be documented on the Punchlist/Resolution form. In the event of rejection of any part or function test procedure, the PCSI shall perform repairs, replacement, and/or retest within 10 days.
 - g. Submit FAT results for review by the Engineer.
3. 30-Day Acceptance Test
- a. After completion of the Operational Readiness and Functional Acceptance Tests, the PCSI shall be responsible for operation of the system for a period of 30 consecutive days, under conditions of the Operational Performance Test specified under Section 16260, without a single non-field

repairable malfunction. The 30-day acceptance test may occur concurrently with the FAT. Network performance monitoring shall continue throughout the 30-day test period.

- b. During this test, operations and PCSI personnel shall be present as required. The PCSI is expected to provide personnel for this test who have an intimate knowledge of the hardware and software of the system. Off-shift emergencies shall be fully supported by PCSI staff. Provide PCSI staff with cell phones and pagers to ensure that support staff is available by phone and/or on-site within 4 hours of a request by operations staff.
- c. While this test is proceeding, City shall have full use of the system. Only operating personnel shall be allowed to operate equipment associated with live pump station processes. Pump station operations shall remain the responsibility of City and the decision of City's operators regarding operations shall be final.
- d. Any malfunction during the tests shall be analyzed and corrections made by the PCSI. Engineer will determine whether any such malfunctions are critical and warrant a repeat of this test. Network performance excursions that exceed the maximum levels for errors developed by the PCSI and specified herein shall constitute a system malfunction.
- e. Any malfunction, during this 30 consecutive day test period, which cannot be corrected within 24 hours of occurrence by the PCSI's personnel, or more than two similar failures of any duration, will be considered as a non-field-repairable malfunction.
- f. Upon completion of repairs, by the PCSI, the test shall be repeated as specified herein.
- g. In the event of rejection of any part or function, the PCSI shall perform repairs or replacement within 10 days.
- h. All computer equipment, network equipment, controllers, data base, process controller logic, and graphical interface system errors must be functioning as required per the specifications prior to the start of each test period. The 30-day test will not be considered successful until all data base points and logic functions are tested and verified to be correct.
- i. The total availability of the system shall be greater than 99.5 percent during this test period. Availability shall be defined as:
 - 1) $AVAILABILITY = (TOTAL\ TIME - DOWN\ TIME) / TOTAL\ TIME$
- j. Down times due to power outages or other factors outside the normal protection devices or backup power supplies provided, shall not contribute to the availability test times above.

3.03 TRAINING

- A. The cost of training programs to be conducted with plant personnel shall be included in the Contract price. The training and instruction shall be directly related to the system being supplied. The PCSI is responsible for training associated with the control panels, instrumentation, hardware, and software.
- B. The training program shall represent a comprehensive program covering all aspects of the operation and maintenance of the system.

- C. All training schedules shall be coordinated with, and at the convenience of City. The training classes shall be scheduled a minimum of 2 weeks in advance of when they are to be given. Each training class shall be conducted twice during separate weeks and at different times to allow for scheduling of shift based City personnel.
- D. Proposed training material, including a detailed outline of each lesson, shall be submitted for review at least 30 days in advance of when the lesson is to be given. Submitted shall be reviewed for suitability and comment provided that shall be incorporated into the course.
- E. Each training class shall be a minimum of four (4) hours in duration. Separate classes shall be conducted for City's maintenance and operating personnel as required by and at the convenience of the City. Maintenance classes shall stress troubleshooting, repair, calibration, and other technical aspects of the HMI system. Operator classes shall stress operational theory and use of the HMI display screens.
 - 1. On-site (field) training shall be performed at the new IPC buildings following successful completion of the FAT, during the 30 – day acceptance test period. On-site testing shall include individual sessions covering the following:
 - a. Detailed hands-on instruction to the City operations personnel covering; system operations including manual and automatic operational functionality of each control panel, PLC, and HMI. Operational training shall also include field instrumentation provided under this Contract.
 - b. Address field debugging, troubleshooting, maintenance procedures, and calibration procedures suitable for performance by operations staff.
- F. The PCSI shall provide detailed manuals to supplement the training courses. The manuals shall include specific details of equipment supplied and operations specific to the project.
- G. The PCSI shall make use of teaching aids, manuals, slide/video presentations, etc. Training sessions shall be recorded. Recordings shall be prepared using DVD format suitable for viewing using MS Windows compatible computers. After the training services, such materials shall be delivered to the City.

END OF SECTION

APPENDIX 13410-A

PLC INPUT/OUTPUT (I/O) LIST

The I/O List is included for reference only. The determination of the exact number and type of I/O points shall be the responsibility of the PCSI based on the Process Control Descriptions per Section 13415, auxiliary device requirements, and spare requirements as shown on the Drawings and specified herein.

I/O LIST: WTP PLC Panel (20-CP-100)

TAG NO.	DESCRIPTIONS	I/O TYPE	RANGE/STATUS	REMARKS
20-UA-000	CONTROL PANEL 120V POWER FAILURE	DI	120V FAIL	
20-UA-000A	CONTROL PANEL UPS BATTERY FAILURE	DI	UPS BATT FAIL	
20-UY-000	CONTROL PANEL AUTODIALER CALL - CRIT PLANT FAIL	DO	AUTODIAL - CRIT	
20-UY-000A	CONTROL PANEL AUTODIALER CALL - PART PLANT FAIL	DO	AUTODIAL - PART	
20-UY-000B	CONTROL PANEL AUTODIALER CALL - UNAUTH INTRUSION	DO	AUTODIAL - INTR	
20-UA-000B	MCC UNAUTHORIZED INTRUSION	DI	INTRUSION	
20-MN-030	GENERATOR RUNNING	DI	RUNNING	
20-UA-030A	GENERATOR ALARM	DI	SHUTDOWN	
20-UA-030B	GENERATOR READY	DI	READY	
20-MD-100	WELL PUMP CALL	DO	START/STOP	
20-UA-100A	WELL PUMP READY	DI	READY	
20-MN-100	WELL PUMP RUNNING	DI	RUNNING	
20-UA-100B	WELL PUMP FAILURE	DI	FAIL	
20-YN-100	WELL PUMP IN AUTO	DI	AUTO	
20-PI-100	WELL EFFLUENT PRESSURE	AI		
20-FI-115	WELL PUMP DISCHARGE FLOW	AI		
20-PAH-200	HYDROPNEUMATIC TANK LOW PRESSURE	DI	LOW PRESSURE	
20-LAH-200	HYDROPNEUMATIC TANK HIGH LEVEL	DI	HIGH LEVEL	
20-MD-410	CALCIUM HYPOCHLORITE PUMP CALL	DO	START/STOP	
20-LAH-410	CALCIUM HYPOCHLORITE SUMP HIGH LEVEL	DI	HIGH LEVEL	
20-LAL-410A	CALCIUM HYPOCHLORITE PUMP SOLUTION LOW	DI	LOW LEVEL	
20-LAH-410	CALCIUM HYPOCHLORITE PUMP SOLUTION HIGH	DI	HIGH LEVEL	
20-LAL-410B	CALCIUM HYPOCHLORITE PUMP TABLET LOW	DI	LOW LEVEL	
20-ZI-410	CALCIUM HYPOCHLORITE PUMP INLET SOLENOID OPENED/CLOSED	DI	OPENED/CLOSED	
20-MN-410	CALCIUM HYPOCHLORITE PUMP RUNNING	DI	RUNNING	
20-SC-410A	CALCIUM HYPOCHLORITE PUMP SPEED CONTROL (RESIDUAL CONTROL)	AO	0.0 - 100.0 %	
20-SC-410B	CALCIUM HYPOCHLORITE PUMP SPEED CONTROL (FLOW CONTROL)	AO	0.0 - 100.0 %	
20-SI-410	CALCIUM HYPOCHLORITE PUMP SPEED FEEDBACK	AI	0.0 - 100.0 %	
20-WI-410	CALCIUM HYPOCHLORITE TABLET WEIGHT	AI	0.0 - 100.0 %	
20-MD-510	AMMONIUM SULFATE PUMP STOP	DO	START/STOP	
20-LAH-510	AMMONIUM SULFATE SUMP HIGH LEVEL	DI	HIGH LEVEL	
20-UA-510	AMMONIUM SULFATE PUMP FAIL	DI	FAIL	
20-MN-510	AMMONIUM SULFATE PUMP RUNNING	DI	RUNNING	
20-SC-510	AMMONIUM SULFATE PUMP SPEED CONTROL	AO	0.0 - 100.0 %	
20-SI-510	AMMONIUM SULFATE PUMP SPEED FEEDBACK	AI	0.0 - 100.0 %	
20-AI-825	FREE RESIDUAL CHLORINE	AI	0 MG/L - 4 MG/L	
20-AI-845	TOTAL CHLORINE PH	AI	7 TO 9.5	
20-TI-845	TOTAL CHLORINE TEMPERATURE	AI	50 DEG F - 70 DEG F	
20-AI-848	TOTAL RESIDUAL CHLORINE	AI	0 MG/L - 4 MG/L	
20-FAH-900	EYEWASH SHOWER HIGH FLOW	DI	HIGH FLOW	
TOTAL I/O COUNT - AI:		9		
DI:		22		
DO:		6		
AO:		3		

NOTES:

1. SPARE I/O POINTS REQUIRED BY THE SPECIFICATIONS ARE NOT INCLUDED IN THIS I/O LIST.

APPENDIX 13410-B

FIELD INSTRUMENT LIST

The Field Instrument List is included for reference only. Only major instruments are included in the Field Instrument List and miscellaneous switches, relays, valves, signal conditioners, process seals, manifolds, and auxiliary devices are not included. Providing all instruments and devices necessary for a fully functioning system shall be the responsibility of the PCSI, based on the Process Control Descriptions per Section 13415, auxiliary device requirements, and spare requirements as shown on the Drawings and specified in these Specifications.

**SECTION 13410
FIELD INSTRUMENT INDEX**

Project: East PA Pad D		Client: City of East Palo Alto			EPA Project No. WS-04-2015/16				
TAG	DESCRIPTION	P&ID	SPECIFICATION		RANGE			SETPOINT	COMMENT
			SECTION	PAR.	LOW	HIGH	UNITS		
20-PIT-100	Well Effluent Pressure Transmitter				20	80	PSI		
20-FE/FIT-115	Well Pump Discharge Flowmeter				100	600	GPM	500	
20-LSH-410	Calcium Hypochlorite Sump High Level Switch					1.0	ft		
20-AE/AIT-825	Calcium Hypochlorite Free CL2 Analyzer								Note 2
20-AE/AIT/TE/TIT-845	Calcium Hypochlorite pH/Temp Analyzer								Note 2
20-AE/AIT-848	Calcium Hypochlorite Total CL2 Analyzer								Note 2
20-LSH-510	Ammonium Sulfate Sump High Level Switch					1	ft		

NOTES

1. NOT ALL DEVICES SHOWN ON THE P&ID ARE INCLUDED ON THIS LIST: HANDSWITCHES, INTERNAL PANEL DEVICES, PACKAGED EQUIPMENT, AND OTHER ITEMS ARE NOT SHOWN
2. FINAL SETPOINTS AND SETTING RANGES TO BE PROVIDED BY THE PACKAGED SYSTEM SUPPLIER.
3. MULTI-FUNCTION INSTRUMENTS MAY BE LISTED FOR EACH SEPARATE OUTPUT AND/OR SENSOR REQUIRED. REFERENCE INTERCONNECTION DIAGRAMS AND SPECIFICATIONS FOR CLARIFICATION OF THE SIGNALS REQUIRED FROM EACH MULTI-FUNCTION INSTRUMENT.

END OF SECTION

SECTION 13415

PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. This Section includes the Process Control Descriptions for the control systems that shall be developed by the Process Control System Integrator (PCSI).
 - 1. Develop the control system applications to implement the process control descriptions for all new systems. All programmable logic controller (PLC) programming, communication networks, and Human-Machine Interface (HMI) graphics and programming shall be performed by the PCSI designated in Section 13410. This Section is provided to define control strategies to be used to program the system.
 - 2. The Contract Documents are a single integrated document, and as such, all Drawings, Specifications Divisions and Specifications Sections apply. It is the responsibility of the Contractor and Subcontractors to review all Sections to ensure a complete and coordinated project.
 - 3. The PCSI is cautioned to read this Section and all related Sections in their entirety prior to starting any programming. Many general control strategies and requirements are defined once in the body of this Section. The PCSI shall implement these general strategies throughout the programming provided under this Contract unless specifically directed otherwise in the detailed Process Control Descriptions.
 - 4. Loop and device tagging criteria shown on the Drawings shall be followed without exception.
 - 5. Programming requirements and graphic display development standards shall be provided and discussed with the City at the first PCS coordination workshop as specified in Section 13410.
 - 6. Final graphic screen HMI interfaces shall match the look and feel of the existing District's HMI systems to the greatest extent possible. General control screen look-and-feel criteria and/or graphic and report samples are available from the District upon request.
- B. Work by the PCSI shall include the work as specified under Section 13410.
- C. Work by City shall be as defined under Section 13410.
- D. Related Sections:
 - 1. Section 13410 – Process Instrumentation and Controls, General Provisions
 - 2. Section 13420 – Control Panels and Hardware
 - 3. Section 13421 – SCADA Controls Hardware and Software

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL

- A. The loop descriptions are broken into a hierarchical layer concept implemented such that control shall only be possible from one location at a time.
 - 1. There may be one layer or multiple layers per loop, depending upon the specific requirements and characteristics of that loop.
 - 2. An example of a multiple layered loop is as follows:
 - a. The lowest layer of control, local control, is at that piece of equipment or that piece of equipment's local control panel.
 - b. The second layer of control is the Motor Control Center (MCC).
 - c. The third layer of control is at the vendor-provided packaged system control panels and includes local Operator devices and/or a vendor-provided Graphical User Interface provided by the system supplier.
 - d. The fourth layer of control is by the Process Control System (PCS) HMI graphical display and Operator interface panel as shown on the Control Block Diagram included in the Drawings.
 - 3. HMI refers to the control computers configured with a graphical interface to the PCS for implementing all Operator-required tasks as described in these specifications. Functions labeled under the HMI shall be able to be implemented at all the PCS HMI's servers and workstations per the Control Block Diagram included in the Drawings.

3.02 GENERAL PROGRAMMING REQUIREMENTS

- A. The requirements specified represent general programming and control loop requirements to be followed by the PCSI for all programming efforts provided under this Contract. These general configuration and control requirements shall be used in conjunction with the detailed process control loop descriptions to provide the complete process control loop functionality. The detailed process control loop descriptions do not describe all common configuration and programming requirements and conversely, these general requirements do not address process control specifics unique to a specific loop. If conflicts occur between these general requirements and the detailed process control descriptions, the detailed requirements shall be followed.
- B. The HMI refers to the computer-based graphical interface for implementing Operator-required tasks. The HMI sends and receives data to a process controller-based control system. The process controllers control and monitor the process equipment (pumps, valves, flowmeters, field sensors, etc.) through the input and output of electrical signals. In general, only loops requiring process controller logic and/or HMI-programmed graphic interfaces are described in the following control loops. Hardwired, relay-based control schemes, where required, are included on the schematic control diagrams included on the Drawings and are not detailed in this Section.
- C. All processor programs shall be configured to allow modification of setpoints, timers, etc. readily by authorized plant personnel using the HMI or as identified in the loop descriptions. Changing operational setpoints shall be password protected. Logic in

the processor program shall be configured to allow modification using the programming devices and software provided under this Contract. All plant control and alarm logic shall be resident in the processors. Processes shall continue to operate properly in automatic mode upon failure of the HMI servers or networks.

- D. Physical/field I/O points shall be mapped to internal variables for use in the control logic. Inputs shall be mapped to internal variables at the beginning of the PLC program scan and outputs shall be mapped from internal variables at the end of the PLC program scan.
- E. All HMI “pushbutton” inputs to the PLC shall be programmed to turn the associated memory bit in the PLC “ON” and upon completion of the required action, the PLC shall turn the associated memory bit “OFF.” Reset of the bit to OFF shall occur at the end of the PLC program scan. Time-based momentary pushbuttons in the HMI software shall not be used.
- F. Any Operator-entered setpoint change (password protected) shall include verification logic within the HMI that requires a second, positive selection of the action by the Operator prior to performing the command. Setpoint controls shall be configured in the HMI to be limited to a predefined range so that values that are unreasonable or outside of the operating range of the associated device cannot be entered. Other Operator-controlled operations (e.g., pump start/stop, open/close valve control) shall in general not require the second positive action. Selection of a control point shall also present the last valid setpoint or command sent to the device.
- G. Incorporate sequence failure logic to issue an alarm if a process control command is not field-verified within an adjustable time period. Sequence failure alarm shall put the associated device(s) in FAIL mode. For example, if a valve is called to open and confirmation of the open valve limit switch is not received after the adjustable time period, issue a valve failure alarm; if a motor is called to run and confirmation of the running motor is not received from the motor starter after the adjustable time period, issue a motor failure alarm. Provide initial failure logic timers set at 10 seconds for motors and 90 seconds for valve open/close operation. Modify fail logic timer based on specifics of the controlled components.
- H. All equipment with an H/O/A or other control mode shown on the Drawings shall indicate at the HMI that the pump is being run in the respective active position (i.e., “Hand” or “Auto” position).
- I. When a power failure occurs, the systems shall fail OFF, OPEN, CLOSE or other Engineer-determined safe position as identified in the loop descriptions or as determined during the initial control system workshop per Section 13410. PLC-controlled equipment shall be restarted automatically to re-establish the process when power is restored unless noted otherwise on the detailed control loop descriptions or where shown on the Drawings. Motor restart after power failure shall include time delays (0–600 seconds) to allow stagger starting of motor loads to limit inrush currents and manage load restart under standby generator. Such motor restart time delays shall only be active following a power failure restart and shall not be executed under normal process control CALL.
- J. Control logic for motors shall be programmed so that if a motor stops for any alarm or interlock other than a power failure it shall not be restarted automatically once the problem with the motor has been resolved.

- K. PLC based Proportional-Integral-Derivative (PID) controllers shall be tuned by the PCSI during Operational Readiness Testing. Tuning of the controllers shall provide either critically-damped or over-damped response, as directed by the engineer, over the entire normal operating range of the control loop. All PID parameters required for tuning and controlling the behavior of the PID controller shall be available at the HMI and shall be accessible by City personnel that are authorized to modify PID functions. PID development shall include a setpoint alarm triggered when the setpoint deviates from the process variable by more than an adjustable deviation band for longer than an adjustable time duration.
- L. All alarms shall display on a process control graphic and shall also be tabulated on a common alarm screen. All alarms must be acknowledged by the plant staff before they can be cleared.
- M. Raw analog counts and/or status bits from the analog input module shall be used as the basis for determination of failed sensors with current outputs outside the normal 4-20 mA range. When an analog signal goes outside the 4-20 mA range due to a failure at the instrument, controller I/O module, system wiring failure, or other means, the following programming shall take place:
 - 1. Issue an instrument failure ALARM.
 - 2. Shutdown the process.
- N. Process alarms that are based on analog input signals shall be generated in PLC logic. Process alarm setpoints shall be adjustable at the HMI and shall be the same variable type as the process variable that they are associated with (e.g. REAL, INTEGER, etc.).
- O. All setpoints for equipment controls, and shutdown conditions derived from analog signals shall be individually configured with adjustable deadbands (initially set at 3% deviation from setpoint) and trip time delays (initially set at 5 seconds) to avoid nuisance tripping and assist with system start-up.
- P. Provide network based data exchange between the Plant PLC and Filter PLC (vendor furnished) as required to achieve the operational requirements detailed in the Loop Descriptions. Data exchange shall occur as block transfer of data arrays and all filter operating parameters shall be displayed at the Plant HMI. Filter control functions shall be operable from the Plant HMI.
- Q. Historical Data Collection - All analog inputs, Operator process control setpoints, and discrete equipment ON/OFF status shall be collected and stored at the local HMI for display on trend screens. Trend screen contents and durations shall be determined based on discussion during the initial process controls workshop specified under Section 13410.
- R. Provide flow totalization as part of process controller logic for all flowmeter inputs to the process controller. Display the totalized flows along with the instantaneous flowrate for each flowmeter at the HMI.
- S. Provide PLC-resident equipment runtime totalization for all equipment where running status is monitored as described in the detailed control loop descriptions.
- T. Monitor PLC condition and central processing unit, power supplies, I/O points, and other components using integral PLC diagnostics. Develop PLC system HMI monitoring graphics for displaying PLC component conditions and alarms.
- U. Provide password protection at the HMI, PLC, and communication network interfaces and control access to the respective devices. Coordinate password

selection and implementation with the City during the Coordination Workshops specified in Section 13410.

V. HMI shall have the following security levels:

1. Level 1 – General HMI password on screen activation, no user data
 - a. Allows for process monitoring and alarm acknowledgement
 - b. Does not allow for manual operation or setpoint changes
2. Level 2 – General HMI password on screen activation, user name & password
 - a. Allows for process monitoring and alarm acknowledgement
 - b. Allows for manual operation and setpoint changes

3.03 DETAILED CONTROL DESCRIPTIONS

A. General

1. The following Detailed Control Descriptions provide an overview of standby well operations and sequencing. The descriptions do not detail all of the required alarming, error-checking, interlocking, and other functions specified and/or necessary for a complete program.
2. Manual operation from the MCC and/or local control stations shall not be dependent on PLC operation. Manual operation at the HMI shall require any MCC and/or local control stations switches to be set to AUTO and/or REMOTE.
3. The (SWS) is not typically staffed and shall normally be operated in “AUTO” mode. Software design shall achieve fully autonomous operation in “AUTO” mode with all necessary protective interlocks to ensure safe operation.
4. When a non-critical equipment failure occurs, algorithms shall automatically adjust parameters as necessary to account any process limitations.
5. Provide time-delays, sequencing, and system parameter checks as required to ensure smooth system transitions. For example, during the transition from In operation to Backwash Mode: shutdown the Well Pump, allow for a time-delay during ramp down (and verify low system pressure), then proceed with changes to valve configuration.
6. Descriptions refer to locations of alarm and control elements. Refer to I/O list for specific termination points of field sensors, switches, and panel lights.
7. Tag names within the Detailed Loop Specific Control Descriptions that refer to variables specific to that loop have been abbreviated to show only the instrumentation functional code and suffix. Complete tag names shall include the plant code prefix and loop number.
8. Unless noted otherwise, all panel mounted lights, control stations, indicators, and signal selectors shall be driven from resident PLC outputs and feed to resident PLC inputs.

END OF SECTION

SYSTEM OPERATIONAL MODES

The East Palo Alto Standby Well general control philosophy employs a centralized PLC, referred to as the Standby Well System PLC or SWS PLC that works with PLCs at local control panels at the Hydropneumatic Tank System and the Tablet Calcium Hypochlorite (Calcium Hypochlorite) Chemical Dosing System to control and monitor the overall system. Together with instrument/analyzers, these PLCs coordinate automatic operation of the system. Control is provided for the following facilities:

1. Well Pump and Hydropneumatic Tank
2. Calcium Hypochlorite Chemical Dosing
3. Ammonium Sulfate Chemical Dosing

The Free Chlorine and Total Chlorine Analyzer Sampling Pumps are operated manually; no automatic control is provided.

High level alarms in the chemical area sumps will stop operations and initiate a cellular dial out to operations staff.

Each component's control strategy is described below.

Well Pump (20-P-100)

- Well Pump (20-P-100) shall have two operational modes: manual and automatic (a.k.a. auto). Auto mode is controlled by the SWS PLC and manual mode is operated at the SWS PLC HMI, located on the MCC.
- In Auto mode, user specifies values at the SWS PLC MHI to control automatic start and stop of the Well Pump (20-P-100). Pump start is based on low hydropneumatic tank pressure and pump stop is based on high hydropneumatic tank level. SWS PLC monitors pressure and level signals from the Hydropneumatic Tank (20-T-200) Local Control Panel (20-CP-200) PLC. SWS PLC also monitors Hydropneumatic Tank (20-T-200) general failure alarm.
- Well Pump discharge PIT (20-PIT-100) high pressure cutoff value is 80 psi and will send an alarm. Well Pump discharge PIT (20-PIT-100) low pressure cutoff value is 20 psi and will send an alarm.

Hydropneumatic Tank (20-T-200) and Hydropneumatic Tank Local Control Panel (20-CP-200); Air Compressor (20-CMP-200) and Air Compressor Local Control Panel (20-CP-201)

- All equipment specified herein is in the scope of supply of the Hydropneumatic Tank System Supplier.
- Hydropneumatic Tank System PLC, located in the Hydropneumatic Tank Local Control Panel (20-CP-200), will monitor tank pressure and level, and communicate these values to the SWS PLC which controls the Well Pump (20-P-100) when in Auto mode.
- Hydropneumatic Tank System PLC will communicate out general failure alarm to the SWS PLC.
- Hydropneumatic Tank Local Control Panel (20-CP-200) shall provide the local alarms and local readouts per the specifications.
- Hydropneumatic Tank System PLC controls Air Compressor (20-CMP-200) operations and the add/vent solenoid valves' operation to maintain high pressure at high level.

- 20-CP-201 is the Air Compressor (20-CMP-200) enclosure housing the compressor HOA, run light, motor starter and alarm lights.

Chlorine Metering Pump System (20-P-410) and Local Control Panel (20-CP-410)

- All equipment specified herein is in the scope of supply of the Chlorine Metering Pump System Supplier.
- Chlorine Metering Pump System (20-P-410) and Local Control Panel (20-CP-410) with PLC is a package system provided by a single supplier that supplies the required chlorine dosage.
- Chlorine Metering Pump System (20-P-410) local PLC controls chlorine dosage. SWS PLC provides instrument values (as described below) and monitors parameters.
- The local PLC controls chlorine dosage, based on receiving the following signals from the SWS PLC: flow rate signal from the Well Pump Discharge Flow Meter (20-FIT-115) and free chlorine residual signal from the Free Chlorine Analyzer (20-AIT-825).
- Chlorine metering pump (20-P-410) delivers chlorine to the process water, based on maintaining a user-specified chlorine residual (specified at the local PLC) as measured by Free Chlorine Analyzer (20-AIT-825) and flow pacing as measured by the Well Pump Discharge Flow Meter (20-FIT-115).
- Chlorine Metering Pump System Local Control Panel (20-CP-410) allows the User to configure chlorine dosing based on both flow and chlorine residual instrument signals (compound loop), which is the preferred control method. Alternatively, User has the option of control based on: flow signal only or free chlorine residual signal only. Finally, manual operation is also provided for at the local control panel.
- Chlorine Metering Pump System Local Control Panel (20-CP-410) shall provide the local alarms and local readouts per the specifications.
- Level probe in chlorine area sump (20-LSH-410) – alarm to operations staff via autodialer

Ammonia Metering Pump System (20-P-510) and Local Control Panel (20-CP-510)

- All equipment specified herein is in the scope of supply of the Ammonia Metering Pump System Supplier.
- Ammonia Metering Pump System (20-P-510) and Local Control Panel (20-CP-510) is a package system provided by a single supplier that supplies the required ammonia dosage to achieve a chloramine residual based on flow signal and biased free chlorine analyzer signal.
- Ammonium Sulfate (Ammonia) metering pump (20-P-510) delivers ammonia to the process water to develop a chloramination residual, based on maintaining a ratio of chlorine to ammonia, specified by User at the SWS PLC HMI, chlorine residual as measured by Free Chlorine Analyzer (20-AIT-825) and flow pacing as measured by the Well Pump Discharge Flow Meter (20-FIT-115).
- Operations staff will observe Total Chlorine Analyzer (20-AIT-848) to confirm the required chloramination residual is being met, and as required refine the ammonia dosage by adjusting User-specified chlorine to ammonia ratio at the SWS PLC HMI.
- Ammonia Metering Pump System Local Control Panel (20-CP-510) shall provide the local alarms and local readouts per the specifications.
- Level probe (20-LSH-510) – alarm to operations staff via autodialer

Free Chlorine Sample Pump (20-P-810) and Chloramine Sample Pump (20-P-840)

- Free Chlorine Sample Pump (20-P-810) pumps free chlorinated water to the Free Chlorine Analyzer (20-AIT-825).
- Chloramine Sample Pump (20-P-840) pumps total chlorine/chloraminated water to the Total Chlorine Analyzer (20-AIT-825), as well as to the pH/Temp Analyzer (20-AIT-845).
- Both sample pumps are manual on/off operation. Package system with local control – no signal back to SWS PLC.

LOOP 825 Free Residual Chlorine (AE/AIT-825)

General:

Free residual chlorine is measured off the Well Pump discharge line inside the chemical area, prior to adding ammonia, and displayed locally and at the SWS PLC HMI. Low-Low, Low, High, and High-High free residual chlorine alarms are generated by the SWS PLC when the free residual chlorine falls below or rises above the corresponding operator entered setpoint.

Control:

The average free residual chlorine is used for residual trim control of the calcium hypochlorite metering pump system, and as part of the trim control for the ammonia metering pump system. Note that the Total Chlorine Analyzer, as described in LOOP 848 does not control any system components.

Field:

None

Local:

None

SWS PLC/HMI:

Low-Low Free Residual Chlorine Alarm Setpoint (AKLL)
Low Free Residual Chlorine Alarm Setpoint (AKL)
High Free Residual Chlorine Alarm Setpoint (AKH)
High-High Free Residual Chlorine Alarm Setpoint (AKHH)

Alarms/Monitoring:

Field:

Free Residual Chlorine (AIT)

Local:

None

SWS PLC/HMI:

Free Residual Chlorine (AI)
Average Free Residual Chlorine (AI-A)
Low-Low Free Residual Chlorine Alarm (AALL)
Low Free Residual Chlorine Alarm (AAL)
High Free Residual Chlorine Alarm (AAH)
High-High Free Residual Chlorine Alarm (AAHH)

LOOP 845 Total Chlorine pH and Total Chlorine Temperature (AE/AIT-845 / TE/TIT-845)

General:

Chloraminated water pH and temperature are measured with a pH Analyzer and displayed locally and at the SWS PLC HMI. Low-Low, Low, High and High-High pH alarms are generated by the SWS PLC when the pH falls below or rises above the corresponding operator entered setpoint.

Control:

For reporting only

Field:

None

Local:

None

SWS PLC/HMI:

Low-Low pH Alarm Setpoint (AKLL)
Low pH Alarm Setpoint (AKL)
High pH Alarm Setpoint (AKH)
High-High pH Alarm Setpoint (AKHH)

Alarms/Monitoring:

Field:

pH (AIT)
Temperature (TIT)

Local:

None

SWS PLC/HMI:

pH (AI)
Average pH (AI-A)
Temperature (TI)
Low-Low pH Alarm (AALL)
Low pH Alarm (AAL)
High pH Alarm (AAH)
High-High pH Alarm (AAHH)

LOOP 848 Total Residual Chlorine (AE/AIT-848)

General:

Chloraminated water total chlorine residual is measured with a Total Chlorine Analyzer and displayed locally and at the SWS PLC HMI. Low-Low, Low, High and High-High Total Chlorine alarms are generated by the SWS PLC when Total Chlorine falls below or rises above the corresponding operator entered setpoint.

Control:

For reporting only

Field:

None

Local:

None

SWS PLC/HMI:

Low-Low Total Residual Chlorine Alarm Setpoint (AKLL)

Low Total Residual Chlorine Alarm Setpoint (AKL)

High Total Residual Chlorine Alarm Setpoint (AKH)

High-High Total Residual Chlorine Alarm Setpoint (AKHH)

Alarms/Monitoring:

Field:

Total Residual Chlorine (AIT)

Local:

None

SWS PLC/HMI:

Total Residual Chlorine (AI)

Average Total Residual Chlorine (AI-A)

Low-Low Total Residual Chlorine Alarm (AALL)

Low Total Residual Chlorine Alarm (AAL)

High Total Residual Chlorine Alarm (AAH)

High-High Total Residual Chlorine Alarm (AAHH)

LOOP 115 Magnetic Flowmeter (FE/FIT-115)

General:

Well pump discharge line is metered and is indicated locally and in SCADA.

Control:

Field:

None

Local:

None

SWS PLC/HMI

Flow (gpm)

Alarms/Monitoring:

Field:

Flow rate (FIT)

Local:

None

SWS PLC/HMI

Flow (gpm)

LOOP 100 Pressure (PIT-100)

General:

The raw water pressure is measured discharge line of the raw water well pump and displayed locally and at the HMI. Low-Low, Low, High, and High-High pressure alarms are generated by the SWS PLC when the pressure falls below, or rises above the corresponding operator entered setpoint.

Control:

None

Field:

None

Local:

None

SWS PLC/HMI:

High Pressure Alarm Setpoint (PKH)

High-High Pressure Alarm Setpoint (PKHH)

Alarms/Monitoring:

Field:

Pressure (PIT)

Local:

None

SWS PLC/HMI:

High Pressure Alarm (PAH)

High-High Pressure Alarm (PAHH)

LOOP 100 Standby Well pump (P-100)

General:

Refer to Well pump operation under System operational modes above.

Control:

Local (at RVSS in MCC):

The pump in the standby well shall not operate below or above discharge flow setpoint (FIT-115).

Hand/Off/Auto (HS-K): When Hand/Off/Auto is in Hand, the pump shall run; when in Auto, control shall be from the SWS PLC/HMI as noted below.

Reset (HS): Resets latched RVSS alarm conditions to normal

SWS PLC/HMI:

Hand/Off/Auto (HS-K). When Hand/Off/Auto is in Auto, the pump shall run based on the process control specified in overall descriptions above.

Call (HS). When in Hand, the operator shall be able to manually start the pump from the SWS PLC/HMI.

Reset (HS)

Alarms / Monitoring:

Local (at RVSS in MCC):

Power On (XI)

RVSS Ready (XI)

Fault Alarm (XA)

SWS PLC/HMI:

Auto (HS)

Run (XI)

Fault Alarm (XA)

Chemical Metering Systems (P-410, P-510)

There are two Chemical Metering Systems:

- Calcium Hypochlorite (Chlorine)
- Ammonium Sulfate (Ammonia)

Calcium Hypochlorite is controlled by the tablet chlorinator PLC which receives flow rate and free chlorine residual signals from the SWS PLC.

MANUAL PLC mode for the Calcium Hypochlorite tablet system is provide for at the tablet chlorinator, using the local PLC HMI

The only chemical feed controlled by the SWS PLC is the Ammonium Sulfate (Ammonia) dosing which is described below.

In MANUAL SWS PLC mode, Operations will be responsible for setting the ammonia

chemical feed rate (gallons per hour) at the SWS PLC HMI. As part of this operation, Operator is responsible for entering the chemical feed rate based on the system flow rate, desired chemical dosage, and active product strength.

In AUTO SWS PLC mode, the SWS PLC controls ammonia chemical feed through pump pacing. Chemical feed pump speeds are calculated on a flow basis using the Well Pump Discharge Flow Meter (FIT-115). Chemical pacing is further refined through PID control loop based on the following analyzers meeting Operator entered setpoints:

- Calcium Hypochlorite –Free Residual Chlorine (AIT-825). Note that the local Calcium Hypochlorite PLC controls dosage based on flow and free residual chlorine values from the SWS PLC
- Ammonium Sulfate – Free Residual Chlorine (AIT-825) and a ratio of chlorine to ammonia user input as described below. This dosing is controlled by the SWS PLC

For the Ammonium Sulfate chemical metering system, the Operator enters the following into the SWS PLC at the HMI:

- Desired dose (mg/L)
- Chlorine to Ammonia ratio
- Active product strength (lbs/gal)
- Metering pump capacity (gph)

Ammonium Sulfate Chemical Metering Systems (P-510) pump speed formula:

Required feed rate (gal/hr) = K * Plant Flow Meter (gpm - FIT-115) * (1 MGD/694.444 gpm) * Ammonia PID

- $K = (\text{desired dose in mg/L}) * (8.34 \text{ lb/MG-mg/L}) * (1 \text{ day}/24 \text{ hr})/(\text{product strength lb/gal})$
- K's unit are: Gal-day/MG-hr

Chemical Sampling Pumps (P-810, P-840)

Chemical sampling occurs at free chlorine and total chlorine process water streams. These pumps operate in manual mode, local control station only.

Chemical analyzers readouts are transmitter to the Plant PLC for HMI display. As is typical, each analyzer signal is error-checked for a failure condition, in which case the appropriate alarm is triggered. Chemical analyzers have the following features:

- Operator setpoints for high-high, high, low, low-low alarms
- When SWS is in operation and a high-high or low-low alarm occurs, move SWS to Standby Mode (Critical Plant Failure).
- When (SWS) is in operation and either of the chemical sumps experience a high level alarm, initiate autodialer callouts in accordance with Partial Plant Failure.

Software Determined Standby Well Station (SWS) Failures

The following is solely intended to clarify intent for (SWS) failure control and is not an exhaustive list. Provide all features as specified and shown on the Drawings. Software determined variables shall be completely described in the SCADA submittal.

Critical Failure

- Function: Halts automatic operations and initiates Standby Mode. Actuates

autodialer callout indicating that the plant has failed and is shutdown. No systems are allowed to be placed into automatic control, but manual system operation is allowed.

- Actuation: Any critical failure such that automatic algorithms are incapacitated or (SWS) is operating in an unsafe manner. This includes but is not limited to: failure of non-redundant equipment, high-high or low-low critical processes, or instrumentation failure.
 - Examples: Well Pump failure, FE/FIT-115 failure, Hydropneumatic tank failure, Calcium Hypochlorite Chemical Metering System failure, Ammonium Sulfate Chemical Metering System Failure, SWS PLC power failure, high-high Total Residual Chlorine, etc.

Emergency Water Shower System (20-EWS-900)

System comes with a flow switch (20-FS-900). When system is running, signal will be routed to Plant PLC

Control:

None

Field:

None

Local:

None

SWS PLC/HMI:

None

Alarms/Monitoring:

Field:

None

Local:

None

SWS PLC/HMI (Standby Well PLC and City Public Works):

Flow Alarm (20-FA-900)

Standby Well Remote Monitoring & Security

The following is solely intended to clarify intent for standby well station security and is not an exhaustive list. Provide all features as specified and shown on the Drawings.

Unauthorized Intrusion

- Function: Indicates a security breach anywhere an intrusion switch has been installed.
- Actuation: Unauthorized intrusion occurs when the maintenance key switch is not actuated within an adjustable time period from 0-5 minutes while an intrusion switch has tripped.

Autodialer

- Function: Dials out over cellular communications to City Public Works as primary callout to alert of any abnormal site conditions.
- In the case of an unauthorized intrusion, dials out to City Police Department as primary callout.
- Employs different pre-recorded messages describing the failure mode.
- Actuation: Discrete outputs from standby well station PLC for Critical Plant Failure, Partial Plant Failure, Unauthorized Intrusion. Autodialer shall have integral feature for callout when under power from its internal battery.

SECTION 13420

CONTROL PANELS AND HARDWARE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Furnish and install process control panels as shown on the Drawings and specified herein.
- B. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and Subcontractors to review all sections to insure a complete and coordinated project.
- C. Related Work
 - 1. Section 13410 – Process Instrumentation and Control, General Provisions
 - 2. Section 13421 – SCADA Controls Hardware and Software
 - 3. Section 16442 – Motor Control Center

Panel Designation	Minimum Panel Size	Enclosure Rating & Type
20-CP-100	As shown on the Drawings	N/A, Mounted in MCC-PD Front Access Only – See Section 16442

1.02 SUBMITTALS

- A. Submittals shall be made in accordance with Section 13410.

1.03 QUALITY ASSURANCE

- A. Refer to Section 13410.

1.04 DELIVERY, STORAGE AND HANDLING

- A. Control panels shall be shipped directly to the site from the factory. Before the control panels are shipped, remove all case-mounted instruments from the face of the panels, and repack in their original shipping cartons for shipment to the site with the control panel
- B. Throughout this Contract, the Contractor shall provide protection for materials and equipment against loss or damage and from the effects of weather. Prior to installation, store items in indoors in a dry location and follow all manufacturers' storage instructions. Provide heating in storage areas for items subject to corrosion under damp conditions. Provide covers for panels and other elements that may be exposed to dusty construction environments. Specific storage requirements shall be in accordance with the manufacturer's recommendations of the equipment being provided.

1.05 SPARES

- A. General:
 - 1. In addition to the items noted below and in the other specification sections, the Contractor shall provide suitable spare parts and expendable items in sufficient

quantities to sustain the SCADA system for a period of 1 year after final acceptance. All spare parts shall be delivered to the site before testing begins.

2. The following tabulation of spare parts and maintenance equipment is presented as a minimum of suitable types and quantities to be provided.
 - a. Provide the following spares:
 - 1) Fuses: 20 percent spares of each size and type used, but no less than 10 of each size and type.
 - 2) Indicating Light Bulb: 20 percent spares of each size and type used, but no less than 10 of each size and type.
 - 3) Power Supplies: 20 percent spares of each size and type used, but no less than one of each size and type.
 - 4) Terminal Blocks: 10 percent spares of each size and type used, but not less than 10 of each size and type.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The dimensions on the attached detail drawings are for general reference only. The PCSI shall be responsible for ensuring final enclosure sizing and panel arrangements accommodate all required equipment for a fully integrated and operational system as specified herein and in the Contract Documents.
- B. Control panels shall conform to the requirements of the NEC Article 409.
- C. Each control panel shall be manufactured and assembled per the requirements of UL 508A. The complete assembly shall bear the UL label as an Industrial Control Panel as defined by UL 508A.
 1. Control panels integrated as part of a motor control center lineup need not bear the UL 508A label, but should otherwise be built to UL 508A standards.
 2. Provide ground fault protective devices, isolation transformers, fuses and other equipment as necessary to achieve compliance with the UL standard.
 3. The Drawings do not detail all UL requirements.
- D. Where two or more units of the same class of materials or equipment are required (e.g. operator pilot devices, terminal blocks, etc.), provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.
- E. Standard products: Unless otherwise indicated, provide material and equipment that is the standard product of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest standard design that conforms to the specifications.
- F. The instruments designated for rear-of-panel mounting shall be arranged within the panel according to respective panel drawings and in a manner to allow for ease of maintenance and adjustment.
- G. The panels shall be completely fabricated, instruments installed and wired at the PCSI's facility.
- H. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any

other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Components mounting shall be oriented in accordance with the internal components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the drawing, specifications, and PCSI's data.

- I. All exterior panel mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.
- J. Nameplates
 - 1. All panels and panel devices shall be supplied with suitable nameplates which identify the panel and individual devices as required. Each device nameplate shall include up to three lines with the first line containing the device tag number as shown on the drawings, the second line containing a functional description (e.g., Well Pump), and the third line containing a functional control description (e.g., Start).
 - 2. Unless escutcheon plates are specified or unless otherwise noted on the Drawings, nameplates shall be 3/32 inch thick, black and white, Lamicoid with engraved inscriptions. The letters shall be Black against a White background unless otherwise noted. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable. Nameplates shall be affixed to the panels using 4-40 thread stainless steel button head hex screws or epoxy adhesive to maintain the integrity of the NEMA panel rating.
 - 3. Provide legend plates or 1-in by 3-in engraved nameplates with 1/4-in lettering for identification of door mounted control devices, pilot lights and meters.

K. Mounting Elevations

- 1. ISA Recommended Practice RP60.3 shall be used as a guide in layout and arrangement of panels and panel mounted components. Dimensions shall account for all housekeeping pads that panels will sit on once they are installed.
- 2. Centerline of indicators and controllers shall be located no lower than 48 inches or higher than 66 inches above the floor on a panel face.
- 3. Centerline of lights, selector switches and pushbuttons shall be located no lower than 32 inches or higher than 70 inches above the floor on a panel face.
- 4. Tops of monitoring lights shall be located no higher than 86 inches above the floor on a panel face.
- 5. Installation of panel components shall conform to component manufacturers' guidelines.

2.02 TYPICAL EQUIPMENT

A. Structure and Enclosure

- 1. Panels shall be of continuous welded-steel construction. Provide steel angle stiffeners as required on the back of the panel face to prevent panel deflection under instrument loading or operation. Internally the panels shall be supplied with a structural steel framework for instrument support purposes and panel

bracing. The internal framework shall permit panel lifting without racking or distortion.

2. The panels, including component parts, shall be constructed and assembled in a thoroughly workmanlike manner and shall be free from sharp edges and welding flaws. Wiring shall be free from kinks and sharp bends and shall be routed for easy access to other components for maintenance and inspection purposes.
3. Each enclosure shall contain Project as-built drawings in a print pocket, 12" wide x 12" high x 2" deep, located on the interior of the door.
4. Where shown on the Drawings, floor mounted enclosures shall have a nominal 12" x 12" folding shelf. Folding shelf shall have steel locking support arms. Panel arrangement shall allow full opening of the folding shelf without obstructions or relocating components, panel wiring, or equipment.
5. Finish Requirements
 - a. All sections shall be descaled, degreased, filled, ground and finished. The enclosure when fabricated of steel shall be finished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane, or lacquer finish which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel, and FRP panels will not require a paint finish.
 - b. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with a solvent. Surface voids shall be filled and ground smooth.
 - c. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before top coating.
 - d. Apply a minimum of two (2) coats of flat white lacquer on the panel interior after priming.

2.03 ENVIRONMENTAL CONTROL

- A. Enclosure shall be provided with a thermostatically controlled strip heater to reduce condensation and maintain the minimum internal panel temperature.
- B. All panels shall be provided with environmental controls (louvers, sun shields, heat sinks, forced air ventilation, air conditioning units, etc.) coordinated by the PCSI with the MCC enclosure cooling system provided under 16442 as required to prevent temperature buildup and maintain homogeneous thermal distribution inside of panel.

2.04 CORROSION CONTROL

- A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Northern Technologies International Corporation, Model Zerust VC; Hoffman Model A-HCl; or approved equal.

2.05 CONTROL PANEL - INTERNAL CONSTRUCTION

- A. Internal Electrical Wiring
 1. All interconnecting wiring shall be stranded, type MTW, and shall have 600 volt insulation and be rated for not less than 90 degrees Celsius. Wiring for systems operating at voltages in excess of 120 VAC shall be segregated from

other panel wiring by either in a separate section of a multi-section panel or behind a removable Plexiglas or similar dielectric barrier. Panel layout shall be developed such that technicians shall have complete access to 120 VAC and lower voltage wiring systems without direct exposure to higher voltages.

2. Power distribution wiring on the line side of fuses or breakers shall be 12 AWG minimum. Control wiring on the secondary side of fuses shall be 14 AWG minimum. Electronic analog circuits shall utilize 16 AWG shielded, twisted pair, cable insulated for not less than 600 volts.
3. Wiring for AC and DC systems shall be routed in separate wireways. Crossing of different system wires shall occur only when necessary and at right angles. Different system wires routed parallel to each other shall be separated by at least 6-inches. Wireways shall not be filled to more than 60 percent visible fill.

B. Terminations

1. All wiring shall terminate onto single tier terminal blocks, where each terminal is uniquely and sequentially numbered. Direct wiring between field equipment and panel components, or between panel components, is not acceptable. A maximum of two wires shall be installed in a single terminal point on both the internal and field wiring side of the terminal blocks.
2. Multi-level terminal blocks or strips are not acceptable.
3. Terminal blocks shall be arranged in vertical rows and separated into groups (AC power, AC control, DC power, DC control). Each group of terminal blocks shall have a minimum of 25 percent spares. Provide unique color coded terminal blocks for different voltages.
4. Discrete inputs and outputs (DI and DO) shall have two terminals per point with adjacent terminal assignments. All active and spare points shall be wired to terminal blocks.
5. Analog inputs (AI) shall have five terminals per shielded pair connection with adjacent terminal assignments for each point. Terminals shall include a fused terminal block for powering loop powered devices, two terminals for connection of the analog input signal, and one terminal for DC common to be used for loop powered devices. The fifth terminal is for shielded ground connection for cable pairs. Note that additional terminals may be required for completion of a current loop of analog devices. Ground the shielded signal cable at the PLC cabinet. Provide additional fusing where required as specified under Division 13. Provide additional terminals to accommodate loops powering multiple devices such as isolators or indicators. All active and spare points shall be wired similarly with circuit wiring completed to the field terminal blocks including all protective devices, circuit tagging, and bundling specified.
6. Analog outputs (AO) shall have three terminals per shielded pair connection with adjacent terminal assignments for each point. The third terminal is for shielded ground connection for cable pairs. Note that additional terminals may be required for completion of a current loop of analog devices. Ground the shielded signal cable at the PLC cabinet. Provide additional fusing where required as specified under Division 13. Provide additional terminals to accommodate loops powering multiple devices such as isolators or indicators. All active and spare points shall be wired similarly with circuit wiring completed to the field terminal blocks including all protective devices, circuit tagging, and bundling specified.

7. Wire and tube markers shall be the sleeve type with heat impressed letters and numbers.
8. Only one side of a terminal block row shall be used for internal wiring. The field wiring side of the terminal shall not be within 6-inches of the side panel or adjacent terminal or within 8-inches of the bottom of free standing panels, or within 3-inches of stanchion mounted panels, or 3-inches of adjacent wireway.
9. Terminal blocks shall be tubular clamp type rated 600 VAC/VDC minimum and as specified on drawings. If fuse terminal blocks are specified, they shall be with built-in puller and with fuse size as required. Provide 20% spare terminals for every terminal strip, space permitting. Terminals shall be clearly and permanently labeled with embossed numbers as shown on drawings. Provide raised and angled terminals for incoming field device circuits.
10. Terminal block jumpers: Where indicated on the drawings, terminal block jumpers shall be pre-made specifically designed for the application. Jumpers designed to screw in on top of terminal blocks are preferred.
11. Provide all necessary accessories, partition plates, separating plates, end cover, group markers, etc., as required for proper installation of the terminal blocks.
12. Standard control terminal blocks:
 - a. Standard control terminal blocks shall be designed to accept No. 22 to No. 12 AWG wires. Terminal blocks shall be gray or beige colored and rated for 30 amperes, 600 VAC/VDC.
 - b. Terminal blocks for analog 4-20mA circuits shall be knife-style isolation (circuit disconnect) type. Provide with IEC disconnect fuse with blown indicator.
 - c. Acceptable products: Allen-Bradley part numbers are listed; approved equals are acceptable:
 - 1) Single Circuit Terminal Block: Allen-Bradley 1492-J4.
 - 2) Two Circuit Terminal Block (For digital I/O field wiring interface applications only): Allen-Bradley 1492-JD4.
 - 3) Knife-Style Isolating Terminal Block (For analog 4-20mA or 1-5VDC applications only): Allen-Bradley 1492-JKD4.
 - 4) Fused Terminal Block: Fused terminal blocks shall have LED for blown fuse indication and be rated for the application. Fuse size shall be ¼" x 1 ¼"; Allen-Bradley 1492-H5 or approved equal.
 - 5) Grounding Terminal Block: Allen-Bradley 1492-JG3.
 - 6) Side Jumpers: Allen-Bradley 1492-N49.
 - 7) Plug-In Center Jumpers: Allen-Bradley 1492-CJLJ6 (where XX is the number of poles).
 - 8) End Anchor: Allen Bradley 1492-ERL35.
 - 9) End Barrier (Single Circuit Terminal Blocks): Allen-Bradley 1492-EBJ3.
 - 10) End Barrier (Two Circuit Terminal Blocks): Allen-Bradley 1492-EBJD4.
 - 11) End Barrier (Grounding Terminal Blocks): Allen-Bradley 1492-EBJ3.

- 12) Marking Systems (1492-J4 and 1492-JG3 terminal blocks): Allen-Bradley 1492-M6X12 (snap-in marker cards) or Allen-Bradley 1492-M5X12.
 - 13) Marking Systems (1492-JD4 terminal blocks): Allen-Bradley 1492-M6X5 (snap-in marker cards)
 - 14) Marking Systems (1492-JKD4 terminal blocks): Allen-Bradley 1492-MS8X12 (snap-in marker cards)
 - 15) Marking Systems (1492-H5 fuse blocks): Allen-Bradley 1492-MS8X12 (snap-in marker cards).
13. Heavy Duty Terminal Block shall be designed to accept wires up to No. 10 AWG. Terminal blocks shall be gray colored and rated for 30 amperes, 600 VAC/VDC. Acceptable products: Allen Bradley 1492 W6, Phoenix Contact Universal "UK" Terminal Blocks, or approved equal.
- C. All wiring to circuits where foreign voltages are present (that is live circuits independent of the panel's normal circuit breaker protection) shall be clearly identified using yellow wiring insulation. The existence of foreign circuits shall also be indicated on the panel exterior by a yellow Phenolic nameplate with red engraved lettering reading "CAUTION FOREIGN VOLTAGES PRESENT".
- D. All wiring shall be clearly tagged on both ends of the wire and color coded. All tag numbers and color coding shall correspond to the panel wiring diagrams and electrical schematic drawings prepared by the PCSI. All power wiring, control wiring, grounding and DC wiring shall utilize different color insulation for each wiring system used. The color coding scheme shall be:
1. Incoming 120 VAC Hot – Black
 2. 120 VAC Hot wiring downstream of panel circuit breaker – Red
 3. 120 VAC Hot wiring derived from a UPS system – Red with Black stripe
 4. 240, 208 or 480 VAC wiring – as specified in Division 16
 5. 120 VAC neutral – White
 6. Ground – Green
 7. DC power or control wiring – Blue
 8. DC analog signal wiring – Black (-), White or Red (+)
 9. Foreign voltage – Yellow
- E. Power supplies and backup power:
1. Provide circuits for all internal panel power distribution including 120VAC, 24VDC, and other voltages as shown on the drawings and specified herein. The PCSI shall be responsible for developing and providing power supply circuitry that conforms to the Project specific requirements per the Contract Documents and approved devices.
 2. PCSI shall be responsible for the final power supply design approach, equipment selection, equipment ratings, wiring, protective devices, and all other elements of the control panel power supplies as specified and shown on the Drawings.

3. Provide power failure under-voltage relays for monitoring panel power supply. Provide power supply failure relays for each power supply provided.
 4. Provide uninterruptible power supply (UPS) for control panels containing PLCs or other sensitive network equipment. UPS shall be 120V, with a minimum VA rating of 125% of design load as sized by PCSI. UPS battery life shall be sized by PCSI to support full design load for a minimum of 20 minutes. PCSI shall submit UPS sizing calculations. UPS shall be APC SMT series or equal.
- F. Provide surge protectors on all incoming power supply lines at each panel per the requirements of Section 13410. Provide control, signal and communication line surge suppression in accordance with Section 13410.
 - G. Each field instrument furnished under Division 13 and shown on the Drawings as deriving input power from the control panel(s) shall have a separate power distribution circuit with a circuit breaker or fuse and blown fuse indication.
 - H. All internal components in the control panels shall be fed from 24 VDC power supplies as required to power field instruments, panel devices, PLCs, switches, etc. 24 VDC power supplies shall be as specified. Internal panel components and control circuits shall have a separate power distribution circuits with a circuit breaker or fuse and blown fuse indication.
 - I. Wiring trough for supporting internal wiring shall be plastic type with snap on covers. The side walls shall be open top type to permit wire changing without disconnecting. Trough shall be supported to the subpanel by stainless steel screws. Trough shall not be bonded to the panel with glue or adhesives. Provide one-inch minimum wire bending radius to prevent wires from being kinked or stressed at the wiring duct junctions. Wiring duct sizes shall not exceed 50%.
 - J. Each panel shall have a single tube, 120V fluorescent light fixture, 20 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be door switch actuated and feature a manual switch integrated into the lamp. Enclosure light fixture shall be as by Hoffman or equal.
 - K. Each panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall be powered from the panel 120V utility circuit.
 - L. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Shield grounding shall be in accordance with the instrumentation manufacturer's recommendations.
 - M. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the requirements of the National Electrical Code.
 - N. Relays not provided under Division 16 and required for properly completing the control function specified in Division 13, Division 16, or shown on the Drawings shall be provided under this Section.

2.06 COMPONENTS

- A. Auxiliary contacts shall be provided for remote run indication and indication of each status and alarm condition. Additional controls shall be provided as specified herein and as required by the detailed mechanical equipment requirements and as shown on the Drawings.

- B. Control panels that contain only low voltage control circuits shall include a DIN rail mounted UL-489 Listed main circuit breaker for branch circuit overcurrent protection and disconnecting means of source power to the control panel.
- C. All components shall be provided with finger safe terminals. Where finger safe terminals are not available for a specific component, the panel shall include insulated barriers to prevent accidental contact with energized components.
- D. All operating control devices and instruments shall be securely mounted on the exterior door for panels installed in interior location, inner dead-front doors for panels installed in outdoor locations, or as shown on the Drawings. All controls shall be clearly labeled to indicate function and shall be in accordance with the electrical area classification indicated on the Electrical Drawings.
- E. Indicator lamps shall be 30mm heavy duty, industrial type, high-visibility LED, full voltage type pilot lights. Device shall match NEMA rating of its enclosure. Units shall have screw on plastic lenses and shall have factory engraved legend plates as required. Lens color shall be green for OFF, red for ON and amber for BYPASS or ALARM. Indicator lamps shall be by Allen-Bradley; Eaton Corporation or approved equal.
- F. Mode selector switches (e.g. HAND-OFF-AUTO, LOCAL-OFF-REMOTE, PUMP SELECTOR, LEAD-LAG, etc) shall be 30mm heavy-duty, industrial type with contacts rated for 120 VAC at 10 Amps continuous. Device shall match NEMA rating of its enclosure. Units shall have standard size, black field, and legend plates with white markings, as indicated. Operators shall be black knob type. Units shall have the number of positions and contact arrangements, as required. Provide spring return style switches where shown on the Contract Documents. Units shall be single-hole mounting, accommodating panel thicknesses from 1/16-in minimum to 1/4-in maximum. Selector switches shall be by Allen-Bradley; Eaton Corporation or approved equal.
- G. Key selector switches shall be 30mm heavy-duty, industrial type with contacts rated for 120 VAC at 10 Amps continuous. Device shall match NEMA rating of its enclosure. Units shall have standard size, black field, and legend plates with white markings, as indicated. Provide a minimum of 6 key copies. Provide spring return style switches where shown on the Contract Documents. Units shall be single-hole mounting, accommodating panel thicknesses from 1/16-in minimum to 1/4-in maximum. Key selector switches shall be by Allen-Bradley; Eaton Corporation or approved equal.
- H. Push-button, shall be 30mm heavy-duty, industrial type with momentary or maintained contacts as required, rated for 120 VAC at 10 Amps continuous. Device shall match NEMA rating of its enclosure. Units shall have standard size, black field, and legend plates with white markings, as indicated. Button color shall be red for EMERGENCY STOP or START and green for STOP. Contact arrangement shall be as required. Local emergency stop pushbuttons shall be red with mushroom head type, non-spring return (pull to reset type). Provide all emergency stop push-buttons with plastic finger guards to minimize risk of accidental pushbutton activation. Push-buttons shall be by Allen-Bradley; Eaton Corporation or approved equal.
- I. Interposing Relays
 - 1. Interposing relays shall be provided where external signal voltages or contact ratings are not suitable for direct interface to control panel components, or as

shown on the Drawings. Interposing relays shall be DIN rail mounted, single pole type, with 6A, 120VAC rated contacts, and coils rated as required for the application. Interposing relays shall be Finder 38 Series, or approved equal.

J. Control Panel Circuit Breakers

1. Panel mounted main or branch circuit overcurrent protection breaker – Breaker shall be 120VAC, thermal magnetic type and be manufactured and tested per UL 489 standards. Short circuit rating shall be a minimum of 10kAIC. Breaker shall be suitable for panel mounting and include a through the door handle mechanism. Breaker shall be manufactured by Eaton, Square D, GE or Equal.
2. DIN rail mounted main or branch circuit overcurrent protection breaker - Breaker shall be industrial, thermal magnetic type, 120VAC rated and be manufactured and tested per UL 489 standards. Short circuit rating shall be a minimum of 10kAIC. Breaker shall be manufactured by Eaton, Allen Bradley, Weidmuller or Equal,
3. Supplementary breakers – Supplementary breakers shall be DIN rail mounted high density, energy limiting type rated for the circuit voltage in which it is installed. Breaker shall be used per the exceptions of the NEC and as tested per UL 1077. Breakers shall be manufactured by Eaton, Allen Bradley, GE or approved equal.

K. Instrument and Panel Power Supply (120VAC to 24VDC):

1. Single-phase DIN-rail mounted, switched-mode power supply with 120VAC input, 24VDC nominal output. Output shall be adjustable and regulated over the range 22.5 to 28.5 VDC. Power supplies shall be sized for their connected load plus 50% spare capacity.
2. The power supply shall have an efficiency greater than 87% with maximum peak-to-peak voltage ripple of less than 100mV.
3. Where shown on the drawings, provide DC power supplies in a fully redundant configuration with a diode bridge redundancy module. The redundancy module shall be of the same manufacturer and series as the power supplies provided, and sized for the full capacity of each power supply. The redundancy module shall include a DC “OK” LED and an alarm contact output.
4. Power supply shall have the following status signals:
 - a. DC “OK” LED which remains lit during normal power supply operation, flashes when the output voltage has dropped by more than 10%, and is off when no input voltage is present.
 - b. An isolated DC “OK” relay contact rated 1A at 30V.
5. Acceptable products: Sola SDN Series, Allen Bradley, Weidmuller, or approved equal.

L. Ground Bar

1. Ground bars shall be UL listed and have suitable number and size of terminals necessary for terminating stranded copper ground wires.
2. Acceptable products: Square D Ground Bar Kits, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install equipment specified above as shown on the drawings within the MCC enclosure. Follow all manufacturers' instructions when installing panel devices and accessories.
- B. Mount circuit breakers below 79-inches.
- C. Mount common switching power supplies on horizontal or vertical DIN rail per the equipment manufacturer's recommendation so that no de-rating is required.
- D. Mount terminal blocks on vertical wireways on the bottom of the panel, unless otherwise noted by the equipment manufacturer. Field and internal terminations shall be on opposite sides of the terminal block. Arrange terminals for segregation of field and internal wires, and segregation of 120VAC wires and signal wires.
- E. Mount PLC I/O modules near the terminal block area. Arrange the modules with 120VAC I/O and signal I/O on opposite sides.

3.02 FIELD QUALITY CONTROL

- A. All control panel and documentation testing shall be in accordance with Sections 13410.

END OF SECTION

SECTION 13421

SCADA CONTROLS HARDWARE AND SOFTWARE

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide programmable logic controllers (PLCs), Human Machine Interface (HMI) workstations, network equipment, and other SCADA ancillary equipment where shown on the Drawings and as specified herein.
- B. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the Contractor and Subcontractors to review all sections to insure a complete and coordinated project.
- C. Provide manufacturer's standard compatible software for all PLC, HMI, and SCADA components where specified herein.
- D. Furnish and install communication and networking equipment including network switches, firewalls, and other equipment as shown on the Drawings and specified herein.

1.02 RELATED WORK

- A. Section 13410 – Process Instrumentation and Controls, General Provisions
- B. Section 13415 – Process Control Descriptions
- C. Section 13420 – Control Panels and Hardware

1.03 SUBMITTALS

- A. Refer to Section 13410.

1.04 MAINTENANCE

- A. As a minimum, provide the following:
 - 1. 10% spare I/O card module of each type provided under this Contract.
 - 2. One spare PLC dedicated rack mounted communication cards of each type provided under this Contract.
 - 3. One spare PLC rack power supply of each type provided under this Contract.
 - 4. Ten percent (10%) (minimum of 2) of each type of miscellaneous components, switches, lights, cable connectors, fiber optic converters, and other field replaceable system components provided under this Contract.
- B. All spare parts shall be carefully packed in cartons, labeled with indelible markings, and shall be adequately treated for a long period of storage. Complete ordering information including manufacturer's part number, part ordering information including manufacturer, part number, part name, and equipment name and number(s) for which the part is to be used shall be supplied with the required spare parts. The spare parts shall be delivered and stored in a location directed by City.

PART 2 - PRODUCTS

2.01 EQUIPMENT – GENERAL

- A. Equipment shall be designed to operate on a 60 Hertz alternating current power source at a nominal 120 volts, plus or minus 10 percent, except where specifically noted. Regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage regulation, constant voltage transformers shall be supplied.
- B. Materials and equipment used shall be UL approved wherever such approved equipment and materials are available.
- C. The system shall be designed and constructed to withstand the demands of real time process management and control.
- D. All equipment, cabinets and devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models that are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion through the installation of plug-in circuit cards or additional cabinets.
- E. All equipment furnished shall be designed and constructed so that in the event of power interruption, or temperatures outside the operational range, the systems specified hereunder shall go through an orderly shutdown with no loss of memory, and resume normal operation without manually resetting when power is restored.
- F. All software required to achieve the functionality described in the Specifications and maintain the system shall be provided. All software provided under this Contract shall be licensed to the City. Coordinate with the City for licensing details and points of contact.

2.02 PROGRAMMABLE LOGIC CONTROLLERS (PLCS) GENERAL

- A. The PLCs shall communicate between the SCADA systems, other control panels, field mounted transducers, switches, controllers, and process actuators. Communications protocol shall be completely transparent to process operators at the HMI. The PLC shall be an intelligent microprocessor based device that can collect data and process control functions. Communications with the operator interface shall utilize the Ethernet 802.3 compliant data highway as shown in the Drawings. The PLC shall reside directly on the Ethernet data highway and communications shall be via a PLC chassis mounted Ethernet communications module as manufactured by the PLC manufacturer. Ancillary or third party Ethernet equipment required to connect the PLC to the Ethernet data highway shall not be acceptable.
- B. All components of the PLC system shall be of commonly recognized industry standards and regularly sold for industrial installations. All components shall be assembled by the PLC manufacturer into standard structurally sound housings. All connecting cables, switches, and other operator-controlled devices shall be constructed so as to withstand, without damage, all normal use and handling. The PCSI as specified in Section 13410 shall be responsible for installation of the equipment in control panel enclosures as specified in Section 13420.
- C. The PLC system shall be of modular design with a plug-in processing unit, input/output cards, or assemblies. All components shall be marketed and supported by the one manufacturer. All necessary auxiliary cables, terminating components,

connectors, and modules shall be included for a fully functioning PLC network system.

- D. The PLC shall be capable of stand-alone operation in the event of failure of the communication links.
- E. The PLC shall be a digital solid state logic system capable of performing the same functions as conventional relays, timers, counters, and math functions. The PLC shall consist of a central processor unit, memory, input/output cards and racks, power suppliers, interconnecting cables, communication lines and other optional items as necessary to meet the functional requirements.
- F. All products shall be designed, manufactured, and tested in accordance with recognized industrial standards. All products shall have corrosion protection. All products shall have UL, CSA and FM approval. The PLC subsystems shall be approved for and adhere to the following agency and environmental specifications:
 - 1. Vibration: 3.5 mm Peak-to-Peak, 5-9 Hz: 1.0G, 9-150 VHz, or 2G @ 10 ... 500Hz. The method of testing is to be based upon IEC 68-2-6 standards for vibration. The system is to be operational during and after testing.
 - 2. Shock: 15G, 11 msec or operating rating of 30G for 11ms and storage rating of 50G for 11ms. The method of testing is to be based upon IEC 68-2-27 standards for shock. The system is to be operational during and after testing.
 - 3. Temperature: All PLC hardware shall operate at an ambient temperature of 0 to 60 degrees C (32 to 140 degrees F), with an ambient temperature rating for storage of - 40 to + 85 degrees C (- 40 to + 185 degrees F).
 - 4. Relative Humidity: The Programmable Controller hardware shall function continuously in the relative humidity range of 5% to 95% with no condensation.
 - 5. Noise Immunity: The Programmable Controller system shall be designed and tested to operate in the high electrical noise environment of an industrial plant as governed by the following regulations: IEEE 472, IEC 801, MILSTD 461B, IEC 255-4, NEMA ICS 2-230.40, and ANSI/IEEE C-37.90A-1978
- G. All system modules, main and expansion chassis shall be designed to provide for free air flow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be permitted.
- H. All major assemblies and sub-assemblies, circuit boards, and devices shall be identified using permanent labels or markings, each of which indicates the manufacturer's catalog number and a product manufacturing date code.

2.03 PROGRAMMABLE LOGIC CONTROLLERS (PLCS)

- A. PLC system manufacturer shall be Schneider Electric Modicon M340 series components with features as specified, or approved equal.
- B. PLC configuration software shall be IEC 61131-3 compliant programming software the same as specified herein for the Secondary PLC hardware.
- C. Major hardware components of the PLC platform shall include:
 - 1. Central Processing Unit (CPU)
 - 2. Input/Output Modules
 - 3. Communications Modules
 - 4. Rack Power Supply Module

D. Central Processing Unit (CPU):

1. General

- a. The CPU shall provide system timing and is responsible for scheduling I/O updates, with no user programming required to ensure discrete or analog update. It shall execute user relay ladder logic programs, communicate with intelligent I/O modules, and perform on-line diagnostics. The CPU shall consist of a single module which solves application logic, stores the application program, stores numerical values related to the application processes and logic, and interfaces to the I/O.
- b. The CPU shall sample all the discrete and analog inputs and outputs including internal coils and registers and service special function modules every scan. The CPU shall process the I/O with user program (s) stored in memory, and then control the outputs based on the results of the logic operation.
- c. The CPU shall execute the user program by rapidly scanning the program stored in user memory. Both logic and data word functions shall be executed in the order they appear in the user program. As each section or rung of logic is solved, the results shall be available to any of the following logic elements.
- d. The CPU shall support an instruction to allow a decrease in scan time by skipping over parts of the program when directed. The CPU shall allow the PLC program to be broken into logic subroutines that execute only when called. The PLC shall allow analog and discrete points to be updated immediately within the scan as the discrete or analog value is called in the configuration program.
- e. The CPU shall be a single printed circuit board utilizing surface mount technology. The CPU shall plug directly into the I/O base and require no additional wiring to the base, power supply, or the I/O.
- f. Provide program execution and support remote or local programming. The CPU shall provide I/O scanning and peer to peer inter-processor communication to other PLCs in the system and to peripheral support devices.
- g. Store programs in either battery backed RAM or non-volatile flash memory. Data registers shall be stored in battery backed RAM.
- h. Provide a battery backed integral real-time clock that can be accessed from the control program. The clock shall include registers for the time of day (year, month, day, hour, minute, second, and day of the week). The real-time clock shall be easily synchronized with an external device such as a PC or another PLC as specified in Section 13415. Permit changing program and data values while running without interrupting the process.
- i. The PLC CPU family shall allow for user program transportability from one CPU model to another.

2. Capacity

- a. The CPU I/O capacity shall be up to 31,744 input and output points, half of which may be analog.

- b. Processor performance shall be rated at least 10,280 instructions per millisecond at a program make up of 100 % Boolean instructions, and 10,070 instructions per millisecond at a program make up of 65% Boolean and 35% numerical.
3. Diagnostics
- a. Read the inputs, perform all system logic, conduct on-line diagnostics, and control the outputs. Diagnostics shall include memory checks, communications monitoring, I/O bus monitoring, watchdog timing, and user program validation.
 - b. Monitor the health of every module in the local and Remote I/O backplanes. A single bit shall show the active or inactive state of each module. Information shall be accessible from the program, from programming software, or remotely from the HMI.
 - c. The CPU shall perform on-line diagnostics that monitor the internal operation of the PLC. If a failure is detected, the CPU shall initiate system shutdown and fail-over if a failure occurs. The following at a minimum shall be monitored:
 - 1) Memory Failure
 - 2) Memory battery low
 - 3) CPU over temperature and general fault
 - 4) Communications port failure
 - 5) Scan time over run
 - 6) I/O failure
 - 7) Analog or special function I/O module failure
 - d. All diagnostic information shall be accessible at the programming terminal which attaches to the CPU. A diagnostic page on the PLC programming terminal shall provide information which identifies the nature of the fault, the absolute memory or I/O address of the fault, and the date and time of occurrence of the fault.
 - e. The CPU shall have LED indicators to show status such as PLC GOOD, PROGRAM RUN, and BATTERY GOOD. If any of the above conditions occur, provide an internal PLC diagnostic fail alarm contact output. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating a "green" indicator when no fault is detected and a "red" indicator when a fault is detected.
4. Memory
- a. The CPU shall contain CMOS RAM program memory or compact flash storage memory. The CMOS RAM or compact flash memory shall have a battery backup system capable of retaining all memory for a minimum of three (3) months under load and shall require no external or special vents. The Compact flash memory shall have the capability to backup RAM contents during power failures. The backup battery shall be capable of being replaced without interruption of memory integrity or PLC process control functions.

- b. A visual indication of backup battery status shall be provided. In the event of low battery voltage, a visual indication and a low battery output alarm contact (for remote alarm) actuation shall be provided before battery failure.
 - c. The program memory shall be sized as required to implement the functions specified plus a minimum of 10 words (16 bit) for each I/O provided as spare, but shall not be less than 48K bytes. The entire program memory shall be available for user program storage. Scratch pad and "housekeeping" programs shall be included in the calculation of the minimum memory size to ensure adequate spare memory is available to the City for future programming requirements.
 - d. The PLC CPU memory shall consist of the following functional types of memory:
 - 1) Logic program memory
 - 2) Constant data memory
 - 3) Variable data memory
 - 4) Input/Output memory
 - 5) CPU status data memory
 - 6) I/O word memory
 - 7) User memory for compiled programs
 - e. Memory allocation and combinations of logic and data storage up to the maximum limits shall be software configurable to match application requirements.
- E. Input/Output Modules (I/O)
- 1. The I/O count and type shall be determined by the PCSI as required to implement the functions specified, as shown in Appendix 13410-A, and including the requirement for active spares as noted below.
 - 2. Each I/O drop or I/O location shall include 20 percent (minimum of two) active input points (both DI and AI) and 20 percent (minimum of two) active outputs points (both DO and AO) for future use. The spares shall be the same type of I/O modules supplied for active process control functions. Spare output points that require the use of an external relay shall be supplied with the external relay. In addition to the indicated wired spares, provide additional 20% spare empty rack space (minimum of two slots) for installation of future I/O cards.
 - 3. All installed unused points on all I/O modules shall be wired to terminal blocks and the termination cabinet in the sequential order that they occur on the I/O modules and in the order that the modules occur in the I/O rack. Termination of all spares at the end of the terminal strips or arbitrarily at random positions on the terminal strips shall not be acceptable. Spare analog input points shall each have their respective internal panel circuiting completed including a powered fuse, a disconnecting terminal block, two feed through terminal blocks and a grounded terminal for connection of the shield. Refer also to Section 13420.
 - 4. I/O module usage shall comply with the following table unless noted otherwise:
 - a. I/O Type Module Type

- b. Analog input 4-20mA (individually isolated, remote power supply) with 12-Bit resolution
 - c. Analog output 4-20mA (individually isolated, remote power supply) with 12-Bit resolution
 - d. Discrete input 24VDC sinking (individually isolated)
 - e. Discrete output 24 VDC sourcing (with interposing relays, including spare points)
5. Minimum isolation between input/output and logic voltage shall be 1500V RMS per NEMA standards via opto-isolation for AC I/O modules and 500 VDC for DC and Analog I/O modules.
 6. Each I/O module shall have field replaceable fuse protection and blown fuse indicators.
 7. Power for discrete and analog instruments shall be provided by the PCSI where required. Each power circuit shall have individual fusing and provided with a readily visible, labeled blown fuse indicator. Grouped fusing shall be acceptable only at each analog input module for loop power.
 8. Each discrete input and output shall have an associated independent interposing relay located in the same control panel.
 9. Where multiple mechanical components are provided for process redundancy, their field connections to I/O modules shall be arranged such that the failure of a single I/O module will not disable all mechanical components of the redundant system (i.e., inputs for Pump No. 1 on one input card, inputs for Pump No. 2 on another input card).
 10. Discrete I/O modules shall contain a maximum of 16 points per card. Analog I/O modules shall contain a maximum of 8 channels per card.

F. PLC Rack Power Supply

1. The power supply shall provide sufficient regulation and ripple control to assure that the rack resident devices being operated can operate within their required tolerances. Output over voltage and over current protective devices shall be provided with the power supply to protect devices from damage due to power supply failure and to protect the power supply from damage due to external failure. Transformers shall have primary and secondary fuse protection.
2. The PLC shall have chassis mounted power supplies to power the chassis backplane, and provide power for the processor and applicable modules.
3. Power supplies shall be 120V and sized by the PCSI as required to meet CPU and I/O module load requirements.

G. Communications Modules

1. Communication Capabilities: The PLC system shall support 10/100Mb Ethernet and Modbus.
2. Ethernet capabilities:
 - a. 10/100MB Ethernet with connection via RJ45 connectors
 - b. Built-in web server supplied with pre-developed and installed system diagnostics screens viewable from any commercial web-browser, and the capability of adding custom developed screens

- c. Modbus TCP messaging
- d. Use of ARP and RARP protocols to insure IP and MAC address correspondence
- e. Ability to be configured as a BootP client or DHCP server.
- f. Support of SNMP.
- g. Global Data support for up to 64 station in each group.
- h. I/O scanning that allows automatic read and write of remote I/O without programming over Modbus TCP protocol.

2.04 PLC PROGRAMMING SOFTWARE

- A. Provide a PLC configuration and application development software package complete with documentation and disks. The software shall be capable of configuration, programming, and online monitoring of all PLCs provided in this contract. All software licenses and warranties shall be assigned to the City by the PCSI.
- B. Support on-line/off-line program development, annotation, monitoring, debugging, uploading and downloading of programs to the PLCs via the Ethernet data highway.
- C. The software package shall be completely menu driven and shall be distributed on standard CD-ROM and USB flash drive.
- D. Include a software license agreement allowing the City the right to use the software as required for any current or future modification, documentation, or development of the PLC's furnished for this project.
- E. The software shall be capable of the following IEC 61131-3 functions:
 - 1. Ladder logic
 - 2. Function block editor
 - 3. Sequential function chart editor
 - 4. List editor
 - 5. Structured text editor
- F. A derived function block editor shall work with any of the above mentioned editors to create custom reusable function blocks. This software shall allow any of the derived function blocks to be modified on-line.
- G. Provide a live simulator which will allow the developer to develop and test programs without the necessity of being connected to a PLC.
- H. Programming Environment
 - 1. The CPU shall be capable of being programmed by an external Windows compatible server device via either a serial or Ethernet communication port on the CPU, or an Ethernet communication module. Serial programming shall be possible without the use of an interface board.
 - 2. The programming device shall have access to the application program, the system configuration, all registers, I/O, system fault status, I/O override, and system diagnostic relays.
 - 3. Application programs may be loaded or stored while the CPU is running with minimal impact on the scan time.

4. If contacts or entire rungs are intentionally deleted from an existing logic program, the remaining program shall be automatically repositioned to fill this void. Whenever contacts or entire rungs are intentionally inserted into an existing program, the original program shall automatically be repositioned to accommodate the expanded program.
5. The number of times a normally open (N.O.) and/or normally closed (N.C.) contact of an internal output can be programmed shall be limited only by the memory capacity to store these instructions.
6. Support multiple industry standard IEC 61131-3 programming languages. As a minimum, ladder logic, function block diagram, instruction list, structured text and Sequential Function Chart (SFC) programming shall be provided. All hardware and software necessary to program the CPU in function block diagram and standard ladder shall be supplied.

I. Instruction Set

1. Perform the same functions as a conventional relay logic system, including relays, timers, counters, and high-level instructions (math, compare, memory pointers, etc.)
2. Perform all functions of conventional three-mode proportional-integral-derivative (PID) analog controllers. Each PID loop shall incorporate an anti-windup algorithm on reset.
3. Address software timers and software counters in any combination and quantity up to the limit of available memory. All management of these instructions into memory shall be handled by the CPU. Instructions shall permit programming timers in the "ON" or "OFF" delay modes. Include the capability to interrupt timing without resetting the timers. Counters shall be programmable using up-increment and down-increment.
4. When using modules such as analog where multiple channels are terminated on one module, it shall be possible to transfer the current status of all channels to the CPU upon execution of one program instruction. This instruction shall be bi-directional to include data transfer from the CPU to the module or from the module to the CPU.
5. Provide for grouping contiguous 16-bit or 32-bit data words into a file. The system shall address up to 1000 files with up to 1000 words per file. Support file manipulation instructions such as high speed "file copy" and "file fill", "file to file" move, "element to file" move, "file to element" move, and "first in-first out".
6. Provide asynchronous and synchronous 16-bit or 32-bit word shift registers. Provide synchronous bit shift registers.
7. Support a "GO TO" instruction to jump over portions of the user program to a portion marked by a matching label instruction.
8. Dynamically manage all data types to ensure consistent data types are maintained.
9. Support execution of ladder or program subroutines. It shall be possible to program several subroutines and define each subroutine by a unique program file designator. The processor will support nesting of subroutines up to seven levels deep. The program format as displayed on the CRT shall clearly define the main program and all subroutines. It shall be possible to pass selected

values (parameters) to a subroutine before its execution. Subroutines shall not be nested more than one layer deep.

10. Provide "HELP" instructions which, when called by the programmer, will display a list of instructions and all data and keystrokes required to enter an instruction into the system memory.
 11. Support entry of comments for all programming platforms. For example, support comment entry for ladder logic rungs, memory addresses, function or programs blocks, or within high level code. Programming platform shall allow engineering comments at the time the programming code is entered.
 12. Fault recovery support: When a major system fault occurs in the system, the fault recovery routine shall be executed and the system shall determine if the fault has been eliminated. If the fault is eliminated, program execution resumes. If the fault still exists, the system will shut down. A user shall have the option to either resume operation or to shut down upon fault detection.
 13. Provide programmable interrupt routines executed regularly over user specified intervals in the range of 1 to 65,535 milliseconds or executed based upon the input condition of one of 16 discrete hardware inputs in the processor chassis.
 14. Support indexed and indirect addressing of inputs and outputs, along with all data table words (integer, binary, floating point, timers, and counters) for the software instruction set.
 15. Supported trigonometric instructions must include Sine, Cosine, Tangent, Inverse Sine, Inverse Cosine, and Inverse Tangent. These instructions must fully support floating point math.
 16. Additional floating point instructions: Log 10, Natural Log, and Exponential.
 17. Support complex, combined calculations in a single instruction, such as flow totalizing or equations of the format $((A+((B-C)*D))/E)$.
 18. Supported file function instructions shall include Sort, Average, Square Root, and Standard Deviation.
 19. Support for ASCII string manipulation instructions such as search, concatenation, extraction, compare, and to/from integer conversion.
 20. Support ladder functions providing ASCII port control such as read, write, handshake line control, buffer examination, etc.
 21. It shall be possible to divide user logic into multiple program blocks (structured programming).
- J. The PLC programming platform shall be Microsoft Windows-based and run in a Microsoft Windows 10 environment and include a 32-bit simulator. The software shall have an extensive on-line Windows-based help screens. Annotation shall be possible from any Microsoft Windows application. Full text import and export of reference data shall also be possible.
- K. The software shall include security features including preventing unauthorized personnel from modifying or downloading the program by or to unauthorized devices.
- L. A one-year software upgrade and support contract shall be provided by the PCSI to the City as part of the cost of this project. The support contract shall include software upgrades for both HMI and PLC programming software for the duration of

the support contract. The support contract shall include free access to online and telephone technical support during normal business hours.

- M. PLC programming software shall be Schneider Electric Unity Pro, or approved equal. Software shall be manufactured by the same manufacturer as the PLC. Provide updates to the PLC programming software to the latest version authorized for use by the City at time of substantial completion.

2.05 COMMUNICATION NETWORKS

- A. The PCSI shall furnish and install the complete IEEE 802.3 compliant Ethernet Local Area Networks (LANs) capable of supporting communications between all switches, HMIs, PLCs as shown on the system architecture block diagram. The PCSI shall furnish all necessary cables, face plates, connectors, modems, transceivers, repeaters, modules, splice kits, etc. required for a complete and operational LAN.
- B. Provide additional, spare network taps as part of each Ethernet network to connect a laptop computer to the networks. The taps must be easily accessible for connectivity.
- C. Control Panel Mounted (Industrial Grade) Ethernet Switches
 1. Where indicated on the Drawings, provide industry-standard ultra wide IEEE 802.3u 100Base-TX autosensing Ethernet switches supporting Fast Ethernet communications over copper cables. Provide managed Ethernet switches with a minimum of six 100Base-TX ports.
 2. Power supply shall be 24VDC.
 3. Switch shall be standard DIN rail mount type for industrial application having a minimum operating temperature of 60 degree C, and listed for installation in a UL508 control panel.
 4. Switches shall include an alarm relay contact output rated for 1 amp at 24VDC.
 5. Switches shall be Moxa EDS-500 series, N-Tron, or equal.
- D. Ethernet 10/100BASE-T/TX Cable: As specified in Section 16120.

2.06 HUMAN MACHINE INTERFACE (HMI) AND PROGRAMMING SOFTWARE

- A. General
 1. The HMI shall read/write data from the PLC as necessary to implement the specified SCADA programming. The HMI shall be suitable for logging a minimum of 2 years of historical data available for display trending or operator retrieval.
 2. Provide and install HMI as shown on the Drawings.
 3. The HMI shall be an industrial touch screen interface, suitable for installation in a UL508A Listed control panel. The HMI shall be NEMA Type 12.
 4. The HMI display shall be a 10.4" diagonal color active-matrix TFT, with minimum 640x480 pixel resolution.
 5. Operating system shall be Windows CE.
 6. The HMI shall be powered using a 24VDC circuit within the control panel in which it is installed.
 7. Provide at least a 32GB SD card for historical data logging.

8. Provide all interconnection and configuration cables required for a complete system. Communications to the PLC CPU shall be via the Ethernet network interface using Modbus TCP protocol.
 9. Provide programming and configuration software used to develop the HMI application. HMI programming software shall be licensed to the City. Programming and configuration software shall be Schneider Electric Vijeo Designer, or approved equal.
- B. Manufacturer: The HMIs shall be manufactured by the same manufacturer as the PLC system. The HMIs shall be Schneider Electric Magelis model HMI GTO series or approved equal.

2.07 AUTODIALER

- A. Auto-Dialer shall be linked to data registers in the PLC over Ethernet and automatically respond in human voice to telephone calls, announcing status and alarms for access via any telephone. The dialer shall automatically dial out through the cellular modem to numbers as designated by the City. Primary phone number dialed shall be programmable depending on the nature of the alarm. This auto-dialer shall be a self-contained device.
- B. Provide solid state programmable auto-dialer for remote notification via dial-up telephone of alarm events. Provide auto-dialer with a minimum of 8 discrete alarm channels.
- C. Provide unit storage of a minimum of 16 telephone numbers via either standard pulse or DTMF dialing. Unit shall be configurable locally from an integral system keypad or remotely over a touchtone telephone. System shall selectively call particular numbers based on the alarm condition received. Provide support for numeric pagers, telephone line fault detection, auto select Tone or Pulse dialing, call progress monitoring (busy, ringing, etc.). Unit shall wait until valid conditions (phone answered) prior to delivering the message.
- D. Provide speech messaging stored in permanent non-volatile solid state memory. Message voice recording may occur locally or via remote telephone. Message duration shall be variable length.
- E. Alarm monitoring shall be based on the presence of AC power and the status of up to 8 contact closure inputs. The following alarm callout conditions shall be implemented:
 1. Autodialer on battery backup (internal)
 2. Unauthorized Intrusion (hardwired)
 3. General Alarm (from PLC discrete output)
 4. Five additional points as determined during the control system workshops specified in Section 13410.
- F. Autodialer shall be capable of future expansion to increase the number of contact closures up to 32 dry contact inputs, up to 16 analog inputs, and remote supervisory control of up to 8 output relays.
- G. Auxiliary Features:
 1. Speakerphone
 2. Real-time clock

3. Battery backup for a minimum of 20 hours continuous operation following a power failure
4. Integral surge suppression on all power, telephone, and signal input lines
5. Sealed front keypad
6. Password protection of unit and configuration
7. UL approved power supply

H. Auto-Dialer shall be RACO – Verbatim Model Series VSS or approved equal.

2.08 CELLULAR MODEM AND ANTENNA

- A. The cellular modem and antenna shall provide wireless communications to the cellular provider as specified by the City and required by the Project.
- B. The cellular modem and antenna shall support the autodialer communications.
- C. The antenna mounting location shall be as determined by the PCSI for superior reception and form/fit.
- D. Provided surge protection between cellular modem and antenna.
- E. The cellular data modem shall be an industrially hardened case suitable for harsh environments and vibration, with a temperature range of -30°C to +60°C and humidity of 95% at 40°C non-condensing. Case shall be DIN rail mountable.
- F. The following configurations shall be available for the unit:
 1. Remote serial gateway
 2. Remote Ethernet bridge
 3. Access point/Remote dual gateway (both serial and Ethernet)
- G. Physical interface shall include:
 1. Ethernet: 10/100/1000BaseTX, RJ-45
 2. Serial: RS-232
- H. Protocols shall include Ethernet per IEEE 802.3, TCP/IP and Serial.
- I. Security shall have encryption and authentication with traffic segregation.
- J. Input power: 10.5 – 30Vdc.
- K. Manufacture and Model No.: RACO Cellularm or approved equal.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

- A. Refer to Section 13410.

3.02 SCADA SYSTEM CONFIGURATION

- A. General:
 1. City addressing approach, screen graphics, and reports will be further defined during the PCSI Coordination Workshops per Section 13410. The configuration specified herein refers to general features and elements of the graphic, alarming, reporting, and other features of the SCADA system. However, all

specific system elements shall conform to the City standards and preference to the greatest extent possible.

2. The PCSI shall provide all development software necessary to perform the work specified herein for HMI development. All other software that may be necessary for a fully configured and operational system including communication configuration and other software shall be provided under this contract. All software licenses and warranties shall be assigned to the City by the PCSI.
3. Refer to Section 13415 for site specific control and system monitoring requirements.
4. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers.
5. The system shall allow the operator to control equipment such as pumps and valves as defined in the control loop drawings and control loop descriptions. All control actions shall require a two step action to assure positive verification of each control operation.
6. Unless specifically noted otherwise, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the HMI operator interface workstation.
7. All components of the SCADA system, including the PLC, HMI, network switch, and autodialer, shall be secured against unauthorized use through a user name and password scheme. Coordinate security access levels and user data with City during PCSI Coordination Workshops.

B. General Displays Requirements

1. Provide graphic, alarm summary, diagnostic, trends, and other displays in conformance with City standards as specified herein.
2. Graphic displays: The display shall depict the basic process diagrams with representative symbols for pumps, tanks, etc., combined with real time process variables or conditions. The displays shall be dynamic (i.e., symbols for a pump shall change color indicating run or stop or alarm, the volume of tanks shall be indicated by varying the height of the interior color of the tank symbol, etc.). All of the current data in the database shall be available for graphic displays. All process variables shall be displayed on their associated display(s) with correct engineering units. Process variables shall display their associated data quality flags.
3. Alarm summary display: The display shall consist of all points currently in alarm and shall include the tag number, description, time of occurrence, and present status (high, low, normal, etc.). The alarm summary shall identify alarm points by severity by utilizing distinct colors for each severity category.
4. Trend displays: The trend display shall display the value of a maximum of eight assigned points versus time. Each point shall be trended in a different color. Each of the assigned points shall have a point identification number, point name, point description, current value, and instrument range displayed in the color used for its trend. The time period shall be selected and be either current or historical. The time period selected and time and date of start shall be displayed. The values displayed on a historical trend shall consist of the stored

values for each variable trended. Current trends shall be updated at the scan frequency of the variable. A trend display shall not be considered a graphic display.

C. Project Specific Graphics:

1. Process graphic displays, shall be based on the P&ID's, site plan drawings, mechanical drawings and electrical drawings included in these contract documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.
2. Screen formats, colors, and layout shall match requirements as defined by the City during PCSI coordination workshops for all graphical screens.
3. At a minimum provide a graphical display for each P&ID, a graphical WTP process overview, a value-driven WTP process overview, a historical alarm log, a data trending display, a equipment runtime display, PLC and communication diagnostic screen, and five additional miscellaneous screens content to be determined during the PCSI coordination workshops. Screen count shall not include auxiliary alarm summary screens, trend screens, or "pop-up" screens used for control or setpoint modifications.
 - a. The value-driven WTP process overview shall include all pertinent process data required to assess WTP operation in a textual table format. If necessary, this screen shall be multiple pages long to accommodate the required data in a legible format.
 - 1) Parameters (Table Y-Axis) include but are not limited to:
 - a) Post-Filtration Chemical Analyzers (Average)
 - b) Post-Blending Chemical Analyzers (Average)
 - c) All Pump Speeds (Average)
 - d) All Levels (Average)
 - e) All Pressures (Average)
 - f) All Flows (Average/Totalized)
 - 2) Analysis Timeframes (Table X-Axis) shall be:
 - a) Instantaneous
 - b) Last Hour
 - c) Last 24 Hours
 - d) Last 30 Days
 - e) Last 180 Days
 - f) All-Time

D. Historical Data Management

1. Historical data logging, archiving, and reporting shall be performed by the on-site HMI.
2. Historical data shall be time and date stamped, with sufficient data points and events logged such that the Gloria Way Well site performance can be analyzed during periodic inspections.

3. Typical event driven historical data recording shall include:
 - a. A point state change occurs (e.g. a digital point changing its state from Off to On)
 - b. A change in data quality (e.g. a value has gone out of range and is no longer valid, a local instrument from which data was being gathered is no longer communicating)
 - c. A value has deviated by more than a specific amount since the last time the value was reported (e.g. a sudden deviation in a value that makes it significant to report)
 - d. A value changing slowly is reported occasionally, but when it starts to change more quickly, it should be reported more often; this is an integration deviation
 - e. A value is expected to be changing but has not changed, indicating a process problem or instrumentation failure
 - f. A value is increasing or decreasing too rapidly
 - g. A value has exceeded operating limits, requiring an alarm to be raised
4. PCSI shall provide historical logging for all I/O listed in the I/O List (Appendix 13410-A) and/or shown elsewhere in the Contract Documents. Required historical data recording parameters shall be further refined during PCSI Coordination Workshops.

3.03 AUTODIALER

- A. Configure autodialer alarms as described in the Project control descriptions in Section 13415.
- B. Coordinate calling sequence with the City and obtain authorized calling telephone numbers during control system coordination workshops specified under Section 13410.

3.04 TESTING

- A. Perform system testing as specified under Section 13410.

END OF SECTION

SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: The general requirements for all of the Equipment and Mechanical work in the scope of the Project, included in Divisions 11, 12, 13, 14 and 15, and elsewhere wherever specifically mentioned in these Specifications.
- B. Related Sections:
 - 1. Section 01650: Facility Startup
 - 2. Section 09960: Protective Coatings
- C. 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 REFERENCES

- A. American Gear Manufacturers Association (AGMA).
- B. American Institute of Steel Construction (AISC).
- C. California Code of Regulations, Title 8 Industrial Relations (CAL/OSHA).
- D. Hydraulic Institute.
- E. National Electrical Manufacturers Association (NEMA).
- F. Occupational Safety and Health Act (OSHA).

1.03 STANDARDS FOR THE WORK

- A. Complete Systems: Provide pipe, fittings, wiring and supports to produce complete, operable systems with all elements properly interconnected. If a specific dimensioned location is not shown for interconnections or smaller system elements, select appropriate locations and show them on Shop Drawing submittals for review.
- B. Provide equipment and material new and without imperfections. Erect 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. Locate oil and lubrication fittings clear of and away from guards, base, and equipment and within reach from the operating floor. Coordinate location of all motor connections in order to properly orient encased electrical conduits. In order to meet these

requirements with equipment as furnished, minor deviation from the Drawings may be made as favorably reviewed by the Engineer.

- C. 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.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Shop Drawings: Submit Shop Drawings to the Engineer and receive favorable review prior to fabrication, construction or delivery to the project site in accordance with Section 01300 of these Specifications. Show 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. Date and sign drawings as certified for use in construction of this project. 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.

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 design and calculations as required in Section 01040.
 - 10. Motor data as specified in Electrical Specifications.
 - 11. List of special tools and/or spare parts to be furnished, if any.
- C. Each piece of equipment, for which certified witnessed or non-witnessed performance tests are required, shall be accompanied by a completed form containing 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). A specific list of the test results plus a list, which shows the values that differ from Specifications.
 - 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.
8. For factory test, receive favorable review of factory test results prior to shipping the equipment.

- D. Instruction Manuals: Prepare and submit instruction manuals covering installation, operation and maintenance of all equipment and machinery specified in Divisions 11, 12, 13, 14 and 15. Refer to Section 01300, paragraph 1.08.
- E. Manufacturers' Affidavits: Where called for in the Specifications, each equipment manufacturer, or his authorized representative, shall submit an affidavit conforming to the requirements of Section 01650, paragraph 1.04.

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.

PART 2 - PRODUCTS

2.01 DESIGN

- A. General: Design all equipment for the service intended, of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection and during continuous or intermittent operation. Adequately stay, brace and anchor, and install equipment in a neat and workmanlike manner. Give consideration to appearance and safety, as well as utility, in the design of details. Use cathodically compatible materials of construction.
- B. Seismic: To be provided by Contractor's Design Engineer.
- C. Controls: 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. The elementary control diagrams as shown on the Electrical Drawings and the diagrams shown on the Instrumentation Drawings are illustrative of control and monitoring requirements pertaining to various equipment of this project. 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. 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 shall be provided under Divisions 16 and 17.

2.02 MATERIALS AND STANDARD SPECIFICATIONS

- A. Materials: Design, fabricate and assemble equipment and systems with new materials and in accordance with acceptable modern engineering and shop practices. Manufacture individual parts to standard sizes and gauges so repair parts can be installed in the field.
- B. Uniformity: 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.

2.03 LUBRICATION

- A. Provide lubricants of types recommended by equipment manufacturers, in quantities sufficient for consumption prior to completion, testing and final acceptance.

2.04 STRUCTURAL METAL FRAMING- NOT USED – CONTRACTOR DESIGN ENGINEER RESPONSIBLE

2.05 EQUIPMENT BASES AND BEDPLATES

- A. Mount equipment assemblies on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Round or chamfer and grind smooth all corners. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting. Mount all equipment bases and baseplates on reinforced concrete pads at least 3 inches high.

2.06 ANCHORS

- A. Each equipment manufacturer shall furnish an anchor bolt pattern and 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. Provide anchor and assembly bolts and nuts of ample size and strength for the purpose intended. All bolts shall be standard machine bolts, with cold pressed hexagon 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. Unless otherwise specified or noted on the Drawings, provide materials as follows:
 - 1. Bolts and nuts in submerged locations or submerged and embedded in concrete or buried in earth, in all exterior locations, and in moist locations: Type 316 stainless steel.

2. Bolts and nuts for supports or equipment in dry locations: Galvanized steel (hot-dipped), with oversize nuts.
 3. Use other bolting materials where specifically called for in the 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. Do not provide expansion type anchors for motor-driven equipment.
- D. Anchor all non-motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive except that, where specifically allowed by note on the Drawing, expansion type anchors may be used.
- E. Where need, Contractor's Design Engineer is responsible for developing technical specification requirements of drilled-in anchors set in epoxy adhesive and for expansion bolt anchors.

2.07 SAFETY GUARDS

- A. Cover belt or chain drives, fan blades, couplings, nip points, 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 may be of solid material. Provide hinged doors with latch for service and lubrication access.
- B. Cover all pipes, manifolds, heaters, and other surfaces which have a surface temperature sufficient to burn human tissue with a thermal insulating material or otherwise guard against contact.
- C. Guards to comply with CAL/OSHA 3940 through 3944.

2.08 LIFTING EYES

- A. Supply all equipment weighing over 100 pounds with lifting eyes. Parts of equipment assemblies which are normally serviced separately, such as motors, to have lifting eyes of their own.

2.09 DRIVES

- A. General: Provide all drive units with a AGMA rating and service factor suitable for 24 hours per day operation under the operating load.
- B. Electric Motors: Conform to the requirements of Electrical Specifications.
- C. V-Belt Drives: Equip each V-belt drive with suitable tension adjustment. Provide drives having a service factor of at least 1.6 with arc length correction at maximum torque using nameplate rating of driving motor.

2.10 NAMEPLATES

- A. Manufacturer's Nameplate: Furnish each piece of equipment and its driver with a corrosion-resistant metal nameplate fastened to the item in a readily readable position. This nameplate to contain the manufacturer's name, equipment rating, capacity, size, model, serial number and speed. All information written or printed to be in English.
- B. Direction of Rotation: Furnish each piece of rotating equipment with a direction of rotation arrow.
- C. Functional Identification: Label each piece of equipment using a Phenolic label, 3/32-inch thick, matte surface, with the functional name and number of the equipment.
 - 1. Fasten labels to the equipment, its base or other acceptable location:
 - a. Letters: 3/8-inch high with the border trim on all sides not less than 1/4-inch.
 - b. Color: Bold background with white letters. Owner to determine background color.
 - c. Fasteners: Brass or stainless steel screwed into inserts, anchor shields or tapped holes in equipment or base.

2.11 PROTECTION AGAINST ELECTROLYSIS

- A. Where dissimilar metals are used in conjunction with each other, provide suitable insulation between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings or bushings.

2.12 SPECIAL TOOLS

- A. For each type of equipment to be furnished, 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.

2.13 FINISHES

- A. Conform to applicable requirements of Section 09960.
- B. Factory Painting: On pumps, motors, drives, starters, control panels and other similar self-contained or enclosed components, apply a factory protective paint system unless otherwise noted. 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: Except where field sandblasting is required, 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. Primer shall be compatible with finish coat.

- D. Rust Preventive: Coat machined, polished, other ferrous surfaces, and non-ferrous surfaces which are not to be painted with rust preventive compound.

2.14 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. If the required sound level cannot be achieved by bare equipment in its designated environment, provide sound attenuating enclosures. 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.
- B. Equipment which when operating has obvious excessive vibrations shall be repaired or replaced as directed by the Engineer. Baseline vibration measurements shall be made where specified.

2.15 FACTORY TESTS

- A. Perform factory tests 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 is hereby made a part of these Specifications. Conduct factory tests at the same speeds and other conditions at which the equipment will operate in the field, except as noted.
- B. Where specifically noted, performance tests may be witnessed by the Engineer or his representative. Inform the Engineer in sufficient time to allow arrangements to be made for witness of such tests. When non-witnessed tests are performed, supply certified results.
- C. Perform factory testing of pumps in accordance with the requirements and standards of the Hydraulic Institute.
- D. Tests of other equipment shall conform to the requirements set forth in these Specifications.

2.16 PIPE SUPPORTS

- A. General:
 - 1. Piping 8 Inches and Larger: Pipe supports are shown on the Drawings for piping 8 inches and larger in diameter, where the piping is shown on layout drawings. Each pipe support used is designed to resist seismic loading except where the support is of the sliding type for thermal expansion. Other supports are provided to resist axial seismic loading of pipes designed for thermal expansion. Pipe supports that are considered seismic resistant are so noted on the pipe support detail sheets on the Drawings. The location and types of supports and braces are indicative and may be modified by the Contractor to suit field conditions, provided the modified support system conforms to the design criteria stated herein, and receives the favorable review of the Engineer. Where piping is shown

schematically only, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated herein and using support details shown on the Drawings. Pipe supports have been designed assuming flanged joints on ductile iron pipe and steel pipe, unless otherwise indicated on the Drawings. If groove type mechanical couplings are used as an alternative, provide additional supports where required, particularly to resist rotation. Shop drawings of these additional supports shall be favorably reviewed by the Engineer prior to installation.

2. Piping Less Than 8 Inches: Pipe supports are generally not shown for piping less than 8 inches in diameter. Where supports are not shown, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated hereinafter and the support details shown on the Drawings. Piping 2-½ inches and larger and all piping for hazardous chemicals shall be supported with pipe supports designed to resist seismic loads. Hazardous chemical piping includes chlorine solution, compressed air, digester cover air, and biogas. Piping smaller than 2-½ inches with non-hazardous contents may be supported with non-seismic resistant supports.
3. Where not detailed or otherwise indicated, pipe support types and spacing shall be in accordance with the Manufacturer's Standardization Society (MSS) Standard Practice No. SP-58 and No. SP-69, except as superseded by the requirements of these Specifications. Hangers and supports used as components of a fire protection system shall comply with NFPA Standard No. 13 and be listed and labeled by UL and FM.

B. Pipe Support System Design:

1. Design Loads: Pipe suspension shall be such as to prevent excessive stress or excessive variation in supporting force while system is in operation. Pipe supports shall support the sum of the weight of the pipe, fittings, appurtenances, and contents. In addition, the pipe shall be anchored to resist internal pressure forces tending to separate any unrestrained joint at pressures 1-½ times the maximum working pressure for the applicable service.
2. Seismic Loads: Seismic loads, expressed as a percentage of the weight of the contributing length of pipe, fittings, appurtenances, and contents, are 45% in any direction within the horizontal plane of the pipe, and 23% up or down within the vertical plane of the pipe.
3. Location: All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at all nonrigid joints, at hose bibbs, and where otherwise shown. Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment.

a. Maximum support spacing shall conform to the following table:

Pipe Size Inches	Pipe Material	Maximum Spacing Feet
------------------	---------------	----------------------

1-inch and smaller	Iron or Steel Copper Plastic Tubing	6 4-1/2 continuous continuous
1-1/4-inch to 2-inch	Iron or Steel Copper or Plastic	8 5
2-1/2-inch to 4-inch	Iron or Steel Copper or Plastic	10 6
6-inch to 8-inch	Iron or Steel Plastic	12 8
10-inch and larger	Iron or Steel	15

- b. Piping penetrations through concrete walls and slabs are considered to resist seismic loading, provided penetrations for pipes 3 inches in diameter and larger are complete with a wall flange.
 - c. Branch piping is not considered to provide resistance to seismic forces.
4. Anchors: Anchors for connecting pipe supports to concrete shall be in accordance with Contractor's Design Engineer specifications.
5. Thermal Expansion Allowance:
- a. Provide one rigid pipe support for each straight run of pipe and between each pair of flexible couplings, flexible connectors, or expansion loops for pipes listed below. Provide other supports at the required spacing that allow sliding or rolling, as noted, along the pipe axis:
 - 1) PVC pipe larger than 1-inch in diameter (sliding inside PVC sleeve).
 - 2) Building heating hot water (rolling).
 - 3) Domestic hot water (rolling).
 - 4) Liquid Oxygen.
 - 5) Aeration Air, Airwash Air, Compressed Air.

Provide vertical support only, that is, no lateral support, within 4 feet of an angle or tee for pipes listed above

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect each item of equipment for damage, defects, completeness, and correct operation before installing.

3.02 PREPARATION

- A. Prior to installing equipment, ensure that the areas are clean. 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 recommendations of the equipment manufacturer.

3.03 INSTALLATION

- A. Structural Fabrications: Conform to the AISC Code and Specification referenced in Article "Structural Steel Fabrications," and conform to Contractor's Design Engineer specifications.
- 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: 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.
 - 1. Make an allowance of at least 1-1/2 inches for grout under the equipment bases, whether or not shown on the Drawings. Use steel shims to level and adjust the bases. 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 a favorably reviewed non-shrink, non-metallic grout.
 - 2. Grout: Dimensionally stable, inorganic, premixed and resistant to acids, alkalis, and salt water, and 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 effect the bond. Use in strict accordance with the manufacturer's recommendations. Provide Five Star Grout as manufactured by U.S. Grout Corporation, Bonsal Construction Grout as manufactured by Bonsal Company, or equal. Submit for favorable review by the Engineer prior to use.
 - 3. Where practicable, place the grout through the grout holes in the equipment base and work 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.
- E. Architectural Metals: Handrails, guardrails, stairs, and other architectural metals furnished as a part of equipment shall conform to the requirements of Section 05500.

3.04 EQUIPMENT STARTUP AND ADJUSTMENT

- A. Arrange for an authorized factory-trained representative of the company or companies supplying the various items of equipment to check the installation and adjust and test the equipment furnished before the acceptance of the work by the Owner. Said representative shall be experienced and knowledgeable of the equipment being tested. Furthermore, he shall assist and instruct the operating staff in adjusting and operating the equipment during the initial plant operation period.
 - 1. Provide initial lubrication for all equipment.
 - 2. Test and demonstrate to the Owner's representative that all equipment operates properly and specified performance has been attained. For pumps, include measurement of suction and discharge pressure at the pump and measurement of pumping rate by volumetric means or through a suitably calibrated meter for two points on the performance curve. For adjustable-speed pumps, conduct tests at a minimum of two speeds. Furnish any test equipment or measuring devices required which are not part of the permanent installation.
 - 3. In addition, demonstrate that the entire facility is in full operating condition prior to the acceptance of the work. Should any equipment or part thereof fail to operate as intended, immediately remove and replace it, all at the Contractor's expense. Pay for all tests involved in this Section.
 - 4. Pressure test equipment and connections thereto as required by these Specifications.

3.05 PERFORMANCE TESTS

- A. Upon completion of the work, and after all systems are set and balanced, conduct performance tests in accordance with Division 1 and other applicable sections of these Specifications. Submit test conditions, test data and results to the Engineer for review.

3.06 SOUND LEVEL TESTING

- A. Not used.

3.07 TOOLS, LOOSE PARTS, AND LUBRICANTS

- A. Tools and Loose Parts Supplied: Provide an inventory of tools and loose parts required to be supplied under the project. Turn over inventory and parts to the Owner. The Owner's written acknowledgment of receipt is required for project completion. Loose parts are defined as items such as special tools, keys, safety equipment, and portable equipment. Refer to Section 01700 and relevant technical sections of these Specifications for additional instructions.
- B. Recommended Spare Parts: Furnish a complete list of recommended spare parts and supplies for each equipment furnished with current prices and a source of supply.

C. Provide a list of all recommended lubricants not listed in the O&M Manuals.

3.08 NOT USED

3.09 NOT USED

3.10 NOT USED

END OF SECTION

SECTION 15080
PIPING INSULATION

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Insulation for piping and related systems.
- B. Related Sections:
 - 1. Section 15050 - Basic Mechanical Materials and Methods.
- C. Inclusion of a specific manufacturer's name in the Specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the Specifications.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A 53 - Specification for Pipe, Steel, Black and Hot-dipped, Zinc-Coated, Welded and Seamless.
 - 2. C 168 - Terminology Relating to Thermal Insulating Materials.
 - 3. C 177 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - 4. C 335 - Test Method for Steady-state Heat Transfer Properties of Horizontal Pipe Insulation.
 - 5. C 518 - Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 6. C 533 - Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 7. C 534 - Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 8. C 547 - Specification for Mineral Fiber Pipe Insulation.
 - 9. C 552 - Specification for Cellular Glass Thermal Insulation.
 - 10. C 585 - Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 - 11. C 591 - Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - 12. C 795 - Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - 13. C 929 - Practice for Handling, Transporting, Shipping, Storage, Receiving and Application of Thermal Insulation Materials for Use in Contact with Austenitic Stainless Steel.
 - 14. C 1136 - Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

15. D 2310 - Classification of Machine-Made "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe.
16. E 84 - Test Method for Surface Burning Characteristics of Building Materials.
17. E 96 - Test Methods for Water Vapor Transmission of Materials.

1.03 DEFINITIONS

- A. Buried: Piping that is installed below buildings, foundations or finish grade, either in soil or encased in concrete in soil.
- B. Concealed: Piping above suspended ceilings and within walls, partitions, shafts, or service spaces and spaces not normally exposed to view but not buried.
- C. Exterior: Piping that is installed outside a building or within a pipe trench or tunnel.
- D. Flame Spread and Smoke Density: Burning characteristics determined in accordance with ASTM E 84. No units apply to value.
- E. Interior: Piping that is installed inside a building.
- F. K Factor: Thermal conductivity determined in accordance with ASTM C 177 or C 518 and expressed in units of BTU-inch/hour-foot²-degrees F.
- G. Mineral Fiber: Fibers manufactured of glass, rock, or slag processed from a molten state, with or without a binder.
- H. Water Vapor Permeance: Water vapor transmission determined in accordance with ASTM E 96 and expressed in units of perm-inch.

1.04 SUBMITTALS

- A. Product Data:
 1. Insulation Properties: Include K factor, thickness, density, operating temperature limits, tensile strength, compressive strength, moisture absorption, flame spread, and smoke developed in accordance with ASTM E 84 and corrosivity to stainless steel piping in accordance with ASTM C 795.
 2. Jacket Properties: Include covering material, cover thickness, tensile strength, tear strength, permeability per ASTM E 96, flame spread, and smoke developed in accordance with ASTM E 84, closure type or devices, and accessories.
 3. Insulating Blankets: Include materials, performance characteristics, method of attaching to equipment, and listing of locations where insulating blankets will be installed.
- B. Manufacturer's Application Instructions: Include assembly and application drawings and detailed instructions.
- C. Laboratory Report: Provide certified laboratory report stating that insulation is not manufactured using chlorinated polymers and does not contain chlorides, bromides, sulfates, or fire-rated materials.

1.05 REGULATORY REQUIREMENTS

- A. For projects located in California, comply with California Energy Commission Energy Efficiency Standards for Residential and Non-residential Buildings.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store insulation materials and accessories under cover and protected from moisture.
- B. Handle and store insulation for use on stainless steel in accordance with ASTM C 929.

1.07 SEQUENCING AND SCHEDULING

- A. Pressure test piping and complete application of coating system before applying insulation.
- B. When piping is to be heat traced, install and functionally test heat tracing before installation of insulation.
- C. Before beginning installation of piping insulation, verify that the ENGINEER has accepted piping tests, pipe coating applications and heat tracing tests.

PART 2 PRODUCTS

2.01 PIPE INSULATION, GENERAL REQUIREMENTS

- A. Insulation Thicknesses: Provide insulation thickness in inches in accordance with the following table. Insulation thickness shown is nominal manufacturing tolerance of 15 percent variation is permissible.

Required Insulation Thicknesses (inches)					
Service Temperature Range as Designated in Insulation Schedule at End of this Section	Nominal Pipe Diameters				
	1 inch & less	1.25 to 2 inch	2.5 to 4 inch	5 to 10 inch	Over 10 inch
Above 200 degrees F	2.0	2.5	3.0	3.5	3.5
100 to 200 degrees F	1.5	1.5	1.5	2.0	2.5
40 to 100 degrees F	0.5	1.0	1.0	1.5	2.0
Below 40 degrees F	1.0	1.0	1.5	2.0	2.0

2.02 PIPE INSULATION

- A. Insulation Types: Provide in accordance with the Insulation types listed and scheduled.
- B. Insulation, Type 1:

1. Insulation Material: Closed cell elastomeric insulation in tubular form.
2. Manufacturers: One of the following or equal:
 - a. Armstrong World Industries, AP Armaflex.
 - b. Apache Products Company, ISO-25.
3. Minimum Temperature Range: Minus 40 degrees F to plus 220 degrees F.
4. K Factor at 75 Degrees F: Not more than 0.27 BTU-in/hr-sq ft-degree F.
5. Fire Ratings:
 - a. Flame Spread: 25 or less.
 - b. Smoke Density: 50 or less for insulation thicknesses up to 1.5 inches.
6. Joints: Seal with manufacturer's recommended contact adhesive to form continuous water barrier.

C. Insulation, Type 2:

1. Insulation Material: Preformed mineral fiberglass insulation made from glass fibers bonded with a thermosetting resin.
 - a. Conform to ASTM C 547, Class 1.
 - b. Provide with factory installed vapor barrier.
 - 1) Material: White kraft paper bound to aluminum foil meeting ASTM C 1136, Type I.
 - 2) Longitudinal Lap Seals: Pressure-sensitive, self-sealing longitudinal lap strip with factory applied adhesive.
 - 3) Circumferential Butt Seals: 4-inch wide tape or similar properties or 4-inch wide overlap with adhesive seal.
 - 4) Vapor Barrier Permeability: 0.02 perms or lower.
 - 5) Vapor Barrier Flame Spread Rating: 25 or less.
2. Minimum Temperature Range: Minus 0 degrees F to plus 850 degrees F.
3. K Factor at 75 degrees F: Not more than 0.23 BTU-in/hr-sq ft-degree F.
4. Average Insulation Density: 3.3 pounds per cubic foot.
5. Maximum Moisture Absorption, Volume Percent: 0.2.
6. Manufacturers: One of the following or equal:
 - a. Owens-Corning Fiberglas Corp., Fiberglas SSL-II.
 - b. Johns Manville, Micro-Lok Fiber Glass Insulation.
 - c. Knauf Fiber Glass, 1,000° Pipe Insulation.

D. Insulation, Type 3:

1. Insulation Material: Rigid cellular glass in accordance with ASTM C 552, Type II.
2. Temperature Range: Minus 450 degrees F to plus 900 degrees F.
3. K Factor at 75 Degrees F: Not more than 0.32 BTU-in/hr-sq ft-degree F.
4. Minimum Average Density: 7.5 pounds per cubic foot.
5. Maximum Moisture Absorption, Volume Percent: 0.2.
6. Minimum Compressive Strength: 87 pounds per square inch.
7. Moisture Permeability: 0.00 perm-inch.
8. Manufacturers: One of the following or equal:
 - a. Pittsburgh Corning Corporation, Foamglas.
 - b. Cell-U-Foam Corporation, Ultra-CUF.

E. Insulation, Type 4:

1. Insulation Material: Asbestos free, rigid calcium silicate in accordance with ASTM C 533; Type I for process temperatures up to 1,200 degrees F.
2. K Factor at 500 degrees F: 0.46 for Type I, 0.70 for Type II.
3. Maximum Average Density: 15 pounds per cubic foot.
4. Compressive Strength: 100 pounds per square inch, to produce a 5 percent compression.
5. Manufacturers: One of the following or equal: In accordance with ASTM C 533 Type I; similar but meeting Type II requirements where Type II required:
 - a. Johns Manville, Thermo-12 Gold.

2.03 INSULATION JACKETS

A. Jacket, Type 1:

1. Material: 28 ounces per square yard polyvinyl chloride on polyester fabric; total thickness 0.028 inches minimum.
2. Fire Rating: 25 maximum flame spread, smoke developed 50 or less.
3. Color: As selected by the ENGINEER from manufacturer's standard colors.
4. Overlap: One-inch minimum at joints and fittings.
5. Joint Seal: Self-sealing lap tape.
6. Fittings: Factory made with full thickness insulation.
7. Manufacturers: One of the following or equal:
 - a. Accessible Products, Thermazip TMZ300.

B. Jacket, Type 2:

1. Material: Ultraviolet resistant polyvinyl chloride jacketing, 20 mil minimum thickness.
2. Fire Rating: 25 maximum flame spread, smoke developed 50 or less.
3. Color: White.
4. Overlap: One-inch minimum at joints and fittings.
5. Joint Seal: PVC solvent welded or adhesive as recommended by the manufacturer.
6. Fittings: Factory made with full thickness insulation.
7. Manufacturers: One of the following or equal:
 - a. Johns Manville, Zeston 2000 PVC.
 - b. Proto Corp., LoSMOKE PVC.
 - c. Speedline Smoke Safe PVC Jacketing System.
 - d. Knauf Covering System.

C. Jacket, Type 3:

1. Material: Aluminum, Alloy 5005; 0.016-inch (26-gauge) minimum thickness.
2. Overlap: Overlap circumferential joints 4 inches minimum; overlap longitudinal joints 1-inch minimum; longitudinal joints oriented to minimize water entry.
3. Bands: 0.5-inch wide, 0.0508-inch (16-gauge) thick aluminum, same alloy as jacket or 0.0179-inch thick Type 304 stainless steel; install on 18-inch centers, uniformly spaced and at all fitting joints.
4. Joint Seal: Apply waterproof adhesive at joints and overlaps.

5. Fittings: Custom fit of same materials.
6. Manufacturers: One of the following or equal:
 - a. Childers Products.
 - b. Premetco International.

2.04 VAPOR BARRIERS

A. Vapor Barrier, Type 1:

1. Material: White kraft paper bound to aluminum foil and meeting requirements of ASTM C 1136, Type 1.
2. Permeability: 0.02 perms or lower.
3. Maximum Flame Spread Rating: 25.
4. Edge Seal: Pressure sensitive tape lap seal.
5. Circumferential Joints: 4-inch wide tape or 4-inch overlap with adhesive seal.

B. Vapor Barrier, Type 2:

1. Material: Mastic.
2. Manufacturers: One of the following or equal:
 - a. Benjamin Foster, No. 30-76.
 - b. Insul-Coustic, No. I.C.-580.
 - c. Foster Products, 36-10/46-10 Weatherite.
 - d. Childers Products CP10/11 Vi-Acryl.

2.05 RELATED MATERIALS

- A. Cover Adhesive: Premium adhesive as recommended by the insulation cover supplier for heavy-duty service in corrosive, wet environments. Standard duty adhesives are not permitted.

2.06 REMOVABLE INSULATING BLANKETS

- A. In piping systems specified to be insulated, use removable insulating blankets for valves, meters, strainers, filters, catalytic converters, engine exhaust silencers, and other in-line piping appurtenances and equipment requiring periodic servicing.
- B. Size Limits: Use removable insulating blankets for equipment and piping appurtenances 3-inch in nominal size and larger. Insulate equipment and piping appurtenances less than 3-inch with molded sections of insulation or by field cutting insulation to conform to the shape of the component and to fit tightly around the component.
- C. Manufacturers: One of the following, or equal:
 1. Pittsburgh Corning, Temp-Mat.
 2. Accessible Products, Thermazip 2000 Jacket.
 3. Thermal Energy Products, Inc., Energy Wrap.
- D. Low Temperature Insulating Blankets Rated up to 800 Degrees F:
 1. Use: For service temperatures up to 800 degrees F.

2. Insulation: Fiberglass fiber, K factor 0.27 at 75 degrees F.
3. Cover: 17-ounce fabric with both sides covered with silicone impregnated glass cloth suitable for temperatures up to 800 degrees F.
4. Cover Fasteners: Use one of the following systems:
 - a. Grommets in the blanket and stainless steel wire.
 - b. 1-inch wide straps with stainless steel rectangular ring buckles and Velcro on strap tail.

E. High Temperature Insulating Blankets Rated up to 1,400 Degrees F:

1. Rated for sustained service temperatures up to 1,400 degrees F.
2. Insulation: Ceramic fiber, K factor 0.50 at 600 degrees F, insulation material suitable for up to 2,300 degrees F, thickness to match adjacent piping insulation specified thickness.
3. Cover: 17-ounce silicone impregnated fiberglass cloth suitable for temperatures up to 1,400 degrees F.
4. Cover Fasteners: Use one of the following systems:
 - a. Grommets in the blanket and stainless steel wire, or
 - b. 1-inch wide straps with stainless steel rectangular ring buckles and Velcro on strap tail.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Before installing insulation, verify satisfactory completion of pressure tests of piping systems and functional tests of heat tracing equipment.
- B. Examine piping surfaces and verify that surfaces are dry and free of loose scale, rust, dirt, oil, or water before applying insulation. When specified, paint or coat pipe surfaces as specified in Section 09960 before installing insulation.
- C. Examine insulation materials and accessories before installation. Do not install insulation and jackets that have been damaged or insulation that has become wet due to exposure to water.

3.02 INSTALLATION

- A. Install insulation and jacket materials in accordance with manufacturer's written instructions.
- B. Apply insulation in smooth, clean manner with tight and finished smooth joints. Fit insulation tightly against surfaces. Insulate each continuous run of pipe with full-length sections of insulation with a single piece cut to length to complete the run of pipe. Do not use cut pieces or scraps to complete the installation.
- C. Butt longitudinal and circumferential insulation joints firmly together.
- D. Maintain the integrity of vapor barrier jacketing. Do not use staples to hold vapor barrier overlaps in place.

- E. Apply sealant or cement when previous applications of adhesives and cement have thoroughly dried.
- F. Apply insulation to permit expansion or contraction of pipelines without damage to insulation or jacketing.
- G. Fittings:
 - 1. Insulate fittings by covering with mitered sections of insulation or utilize factory-made prefabricated fitting shapes.
 - 2. Terminate preformed pipe jackets or covering at sufficient distance from flanges to permit removal of bolts.
 - 3. Overlap flange and flanged fitting insulation on adjacent pipe covering by at least 2 inches.
- H. Valves:
 - 1. Insulate valves 3-inch in nominal size and larger with removable insulating blankets.
 - 2. Size blanket to extend up to packing gland only so that replacement of packing does not require removal of insulating blanket.
- I. Provide continuous insulation through and over pipe supports and provide protection saddles at supports.
- J. Extend insulation against insulation end protection shields or covers so that insulation voids do not exist and provide water tight end seals and covers where insulation terminates.
- K. Insulate pipeline strainers to permit removal of strainer basket without disturbing insulation on strainer body.
- L. Provide continuous pipe insulation and covering through sleeves or openings in walls and floors. When buried pipe enters a building through a below grade wall or slab penetration, begin insulation system on interior side of penetration.
- M. Apply premolded pipe insulation with extended legs when used on pipe traced with either tubing or electric cable type.
- N. Apply piping identification on jackets as specified in Section 15075.

3.03 INSULATION SCHEDULE

Service Designation ⁽¹⁾	Location ⁽²⁾	Insulation Type ⁽³⁾	Jacket Type ⁽³⁾	Service Temp. °F ⁽⁴⁾	Vapor Barrier
S - Sample Lines	Chemical Area	1,2	1,2,3	60	2

Service Designation ⁽¹⁾	Location ⁽²⁾	Insulation Type ⁽³⁾	Jacket Type ⁽³⁾	Service Temp. °F ⁽⁴⁾	Vapor Barrier
<p><u>Notes:</u></p> <p>(1) Refer to Piping Schedule in 02400 for service designations.</p> <p>(2) Insulate interior piping only where indicated on the Drawings.</p> <p>(3) CONTRACTOR may select from options listed.</p> <p>(4) Unless noted otherwise, use service temperature range provided in this table to establish insulation thickness as required by Table in Paragraph 2.01A.</p>					

END OF SECTION

SECTION 15100
GENERAL VALVE REQUIREMENTS

PART 1 – GENERAL

1.01 SUMMARY

- A. Section Includes: General requirements for valves, including features, accessories, materials, and installation.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
- B. American Water Works Association (AWWA):
 - 1. AWWA C207 – Steel Pipe Flanges for Waterworks Service – Sizes 4-Inch Through 144-Inch.
 - 2. AWWA C500 - Gate Valves for Water Systems.
 - 3. AWWA C509 - Resilient-Seated Gate Valves for Water Systems.
 - 4. AWWA C540 - Power-Actuating Devices for Valves and Sluice Gates.
 - 5. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.
- C. American National Standards Institute (ANSI):
 - 1. ANSI/NSF Standard 61 – Drinking Water System Components – Health Effects.
 - 2. ANSI B2.1 - Specifications, Dimensions, Gauging for Taper and Straight Pipe Threads (except dry seals).
 - 3. ANSI B16.10 - Face-to-Face and End-to-End Dimensions of Valves.
- D. Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS):
 - 1. MSS-SP-60 - Connecting Flange Joint Between Tapping Sleeves and Tapping Valves.

2. MSS-SP-61 - Pressure Testing of Steel Valves.
3. MSS-SP-72 - Ball Valves with Flanged or Butt-Welding Ends for General Services.
4. MSS-SP-80 - Bronze Gate, Globe, Angle and Check Valves.
5. MSS-SP-82 - Valve Pressure Testing Methods
6. MSS-SP-98 - Protective Epoxy Coatings for the Interior of Valves and Hydrants.

1.03 SYSTEM DESCRIPTION

- A. All of the valves, devices, and materials specified herein are intended to be standard for its respective use in controlling the flow of potable water shall be certified as being compliant with ANSI/NSF Standard 61.
- B. Valves, appurtenances and miscellaneous items shall be installed as shown on the Drawings and as specified, so as to form complete workable systems.

1.04 SUBMITTALS

- A. Shop Drawings
 1. Submit complete product data and shop drawings required to establish compliance with these Specifications in accordance with Section 01300.
 2. Submittals shall include as a minimum:
 - a. Certified drawings showing all important details of construction and dimensions.
 - b. Descriptive literature, bulletins and/or catalogs of the valve assemblies.
 - c. The total weight of each item.
 - d. A complete bill of materials.
 - e. Valve Cv data and head loss characteristics (maximum pressure drop) as a function of the entire flow range for both full open and 10, 20, 30, 40, 50, 60, 70, 80, and 90 percent open.

- f. Actuator torque requirements for normal and maximum pressure operation.
- g. Operations and Maintenance Manual.

B. Quality Control

1. Certificates

- a. For each valve specified to be manufactured, tested and/or installed in accordance with AWWA and other standards, submit an affidavit of compliance with the appropriate standards, including certified results of required hydrostatic tests and certification of proper installation.

2. Manufacturer's Installation and Application Data

3. Operation and Maintenance Data

- a. Operation and maintenance instructions shall be furnished to the Engineer as provided in Section 01730. The instructions shall be prepared specifically for this installation and shall include all required product data, drawings, equipment lists, descriptions and other information required to instruct operating and maintenance personnel unfamiliar with such equipment.

1.05 QUALITY CONTROL

A. Qualifications

- 1. Valves and appurtenances shall be products of well established firms who have a minimum of 10 years continuous current experience, are reputable, and qualified in the manufacture of the particular products to be furnished.
- 2. All units of the same type shall be the product of one manufacturer.

B. Certifications

- 1. The manufacturers shall furnish an affidavit of compliance with Standards for testing required for certain items in addition to that required by referenced standards.

C. Provide the services of a qualified and factory-trained service representative(s) of the manufacturer(s) to provide operational and maintenance instruction, for a total of one-day, eight hour period for all valve and valve components requiring

operator maintenance or adjustment.

- D. Inspection of the units may be made by the Engineer after delivery. The equipment shall be subject to rejection at any time due to failure to meet any of the Specification requirements, even though submittal data may have been accepted previously. Equipment rejected after delivery shall be marked for identification and shall be removed from the job site within 5 working days.

1.06 DELIVERY, STORAGE AND HANDLING

A. Packing and Shipping

- 1. Care shall be taken in loading, transporting and unloading to prevent injury to the valves, appurtenances, or coatings. Equipment shall not be dropped. All valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage to the coatings shall be repaired to a new condition.
- 2. Prior to installation, the ends of all valves shall be acceptably covered to prevent entry of foreign material. Covers shall remain in place until installation. Oxygen-cleaned valves shall be suitably protected to preserve the integrity of the cleaning process. Uncovered or contaminated valves shall be re-cleaned for oxygen service.
 - a. All valves 3-in and larger shall be shipped and stored on site until time of use with wood or plywood covers on each valve end.
 - b. Valves smaller than 3-in shall be shipped and stored as above except that heavy cardboard covers or plastic plugs may be used on the openings.
 - c. Rising stems and exposed stem valves shall be coated with a protective oil film which shall be maintained until the valve is installed and put into use.
 - d. Any corrosion in evidence at the time of acceptance by the Owner shall be removed and repaired, or the valve shall be removed and replaced.

B. Storage and Protection

- 1. Special care shall be taken to prevent plastic and similar brittle items from being directly exposed to the sun, or exposed to extremes in temperature, to prevent deformation. See the individual piping specifications and manufacturer's information for further requirements.

1.07 MAINTENANCE

- A. Special tools and the manufacturer's standard spare parts, if required for normal operation and maintenance, shall be supplied with the equipment, as specified herein.
- B. Provide all special tools required for normal maintenance. Tools shall be packaged in a steel case, clearly and indelibly marked on the exterior to indicate equipment for which tools are intended.
- C. Provide to the Owner a list of all spare and replacement parts with current individual prices and location where they are available.

PART 2 - PRODUCTS

2.01 MATERIALS - GENERAL

- A. Valves and appurtenances shall have the name of the maker, nominal size, flow directional arrows, working pressure for which they are designed and standard referenced, cast in raised letters or indelibly marked upon some appropriate part of the body.
- B. Unless otherwise noted, items shall have a minimum working pressure of 150 psig or be of the same working pressure as the pipe they are connected to, whichever is higher and suitable for the pressures noted where they are installed.
- C. Joints, size and material - unless otherwise noted or required by the Engineer:
 - 1. Except where noted, all joints referred to herein shall be of the same type, nominal diameter, material, and with a minimum rating equal to the design capacity of the pipe or fittings to which they are connected.
 - 2. Unless otherwise noted on the Drawings, valves and appurtenances shall be of the same nominal diameter as the pipe or fittings to which they are connected.
- D. Provide all special adapters as required to ensure compatibility between valves, appurtenances and adjacent pipe.

2.02 EQUIPMENT

- A. The valve manufacturer shall supply, and rigidly mount all actuators, including any type of manual or powered actuators, on valves at the factory. The valves

and their individual actuators shall be shipped as a unit.

- B. Unless otherwise noted, valves shall be manually actuated; non-buried valves shall have an operating wheel, handle or lever mounted on the operator; buried valves and those with operating nuts shall have a non-rising stem with an AWWA 2-in nut.
- C. All actuators shall be capable of moving the valve from the full open to full close position and in reverse and holding the valve at any position part way between full open or closed.
- D. All valves shall be left hand to open (counterclockwise), clockwise to close. Each operating device shall have cast on it the word "OPEN" and an arrow indicating the direction of operation.
- E. Gear Actuators
 - 1. Unless otherwise noted, gear actuators shall be provided for the following: all valves of larger than 8-in nominal diameter; all buried valves with operating shaft mounted horizontally (butterfly, plug, etc); where specified and/or indicated on the Drawings; where manual operator effort is greater than 40 ft-lbs rim pull.
 - 2. Gear actuators shall be of the worm or helical gear type with output shaft perpendicular to valve shaft, having a removable hand wheel mounted on the output shaft. Unless noted they shall conform to AWWA C504, but except with butterfly valves, need not be certified.
 - 3. Actuators shall be capable of being removed from the valve without dismantling the valve or removing the valve from the line.
 - 4. Gearing shall be machine-cut steel designed for smooth operation. Bearings shall be permanently lubricated, with bronze bearing bushings provided to take all thrusts and seals and to contain lubricants. Housings shall be sealed to exclude moisture and dirt, allow the reduction mechanisms to operate in lubricant and be of the same material as the valve body.
 - 5. Manual operator input effort to the handwheel shall be a maximum of 40 ft-lbs for operating the valve from full open to full close, under any conditions. Gear actuators shall indicate valve position and have adjustable stops. Maximum handwheel size shall be 24-in diameter.
- F. All position indication and direction of opening arrows shall be embossed, stamped, engraved, etched or raised decals.
- G. Unless otherwise noted, all valves larger than 3-in nominal diameter shall be provided with position indicators at the point of operation.

- H. Where required on the Drawings, furnish position indicating switches on valves. Switches shall be pilot duty double pole, double throw, at either limit of open or close or both limits as shown. Switches shall be enclosed in a NEMA 4X enclosure and contacts shall be rated a minimum of 10 amperes at 120 volts A.C.

2.03 FABRICATION

- A. Assembly: All operator and valve assemblies shall be match marked during mounting with indelible markings to illustrate proper relative orientation and facilitate disassembly and reassembly in the field.
- B. Operators for valves shall be provided with support assemblies. Factory mounting of operator and valve shall include placement of 1/4" galvanized carbon steel operator support plate between operator and valve. Operator stem and coupling shall be of sufficient length to accommodate 1/4" plate.
- C. Ball valves that require the ball to be drilled to allow the venting of gas (e.g., sodium hypochlorite, hydrogen peroxide, etc.) shall have the drilling completed by the manufacturer in the factory and shall be fully guaranteed by the valve manufacturer.

2.04 FINISHES

- A. Notwithstanding any of these Specifications, all coatings and lubricants in contact with potable water shall be certified as acceptable for use and contact with potable water and compliant with Air Quality Management District.
- B. If not specified herein, exterior coatings shall comply with the requirements for industrial coatings per the manufacturer's recommendation, subject to approval by the Engineer.
- C. The exterior surface of various parts of valves, operators, floor-stands and miscellaneous piping shall be thoroughly cleaned of all scale, dirt, grease or other foreign matter and thereafter one shop coat of an approved rust-inhibitive primer shall be applied in accordance with the instructions of the paint manufacturer or other primer compatible with the finish coat provided.
- D. Special care shall be taken to protect uncoated items and plastic items, especially from environmental damage.

PART 3 - EXECUTION

3.01 INSTALLATION - GENERAL

- A. The Contractor shall exercise due care in loading, unloading, and handling, and storage of the valves and actuators. The Contractor shall be solely responsible

for any damage to the valves and actuators, and shall repair any valve or actuator damaged in handling or storage to the satisfaction of the Engineer at no additional cost to the Owner.

- B. All valves and appurtenances shall be installed per the manufacturer's instructions in the locations shown, true to alignment and rigidly supported. Any damage to the above items shall be repaired to a new condition before they are installed.
- C. Install all brackets, extension rods, guides, the various types of operators and appurtenances as shown on the Drawings, or otherwise required. Before setting these items, check all Drawings and figures which have a direct bearing on their location. The Contractor shall be responsible for the proper location of valves and appurtenances during the construction of the Work.
- D. All materials shall be carefully inspected for defects in construction and materials. All debris and foreign material shall be cleaned out of openings, etc. All valve flange covers shall remain in place until connected piping is in place. All operating mechanisms shall be operated to check their proper functioning and all nuts and bolts checked for tightness. Valves and other equipment which do not operate easily, or are otherwise defective, shall be repaired or replaced at no additional cost to the Owner.
- E. Unless otherwise noted, joints for valves and appurtenances shall be made up utilizing the same procedures as specified under the applicable type connecting pipe joint and all valves and other items shall be installed in the proper position as recommended by the manufacturer. Contractor shall be responsible for verifying **manufacturers'** torquing requirements for all valves.

3.02 INSTALLATION OF MANUAL OPERATIONAL DEVICES

- A. Unless otherwise noted, all operational devices shall be installed with the units of the factory, as shown on the Drawings or as acceptable to the Engineer to allow accessibility to operate and maintain the item and to prevent interference with other piping, valves and appurtenances.
- B. For manually operated valves 3-in in diameter and smaller, valve operators and indicators shall be rotated to display toward normal operation locations.
- C. Floor boxes, valve boxes, extension stems and low floor stands shall be installed vertically centered over the operating nut, with couplings as required and the elevation of the box top shall be adjusted to conform to the elevation of the finished floor surface or grade at the completion of the Contract. Boxes and stem guides shall be adequately supported during concrete pouring to maintain vertical alignment.

3.03 FIELD QUALITY CONTROL

- A. Take care not to over pressurize valves or appurtenances during pipe testing. If any unit proves to be defective, it shall be replaced or repaired to the satisfaction of the Engineer.
- B. No testing shall be performed until the manufacturer's service representative has provided written certification that the installed valves have been examined and found to be in complete accordance with the manufacturer's requirements.
- C. Functional Test: Prior to process and plant startup, all items shall be inspected for proper alignment, quiet operation, proper connection and satisfactory performance. All units shall be operated continuously while connected to the attached piping, without vibration, jamming, leakage, or overheating and perform the specified function.
- D. The various pipelines in which the valves and appurtenances are to be installed are specified to be field tested. During these tests any defective valve or appurtenance shall be adjusted, removed and replaced, or otherwise made acceptable to the Engineer.
- E. Various regulating valves, strainers, or other appurtenances shall be tested to demonstrate their conformance with the specified operational capabilities and any deficiencies shall be corrected or the device replaced or otherwise made acceptable to the Engineer.

3.04 CLEANING

- A. All items (including valve interiors) shall be cleaned prior to installation, testing and final acceptance.
- B. Following installation, field clean all valves, etc., that will come in contact with the oxygen, ozone, ozone off gas, and supplemental nitrogen gas. Submit details of the procedure to be used to ensure hydrocarbon and welding residue decontamination of the piping system. The selected procedure used shall be one that is used in the oxygen manufacturing industry. The Contractor shall provide services of a qualified specialty cleaning and decontamination contractor for this work. The name and qualifications of this specialty contractor shall be submitted to the Engineer a minimum of 60 days prior to the start of cleaning procedures. Upon completion, the system shall be dried using dry nitrogen gas and inspected by the specialty cleaning contractor to ensure compliance with the cleaning procedure requirements. The Contractor shall pay for all cleaning and drying materials used for field cleaning.

END OF SECTION

SECTION 15120
BUTTERFLY VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Metal body butterfly valves.
- B. Inclusion of a specific manufacturer's name in the Specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the Specifications.

1.02 REFERENCES

- A. American Society of Mechanical Engineers/American National Standards Institute/(ASME/ANSI):
 - 1. ASME/ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250.
 - 2. ASME/ANSI B16.5 - Pipe Flanges and Flanged Fittings, NPS 1/2 through NPS 24.
- B. American Society for Testing and Materials (ASTM):
 - 1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. A216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for Higher-Temperature Service.
 - 3. A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 4. A351 - Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.
 - 5. A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 - 6. A479 - Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
 - 7. A515 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service.
 - 8. A516 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
 - 9. A536 - Standard Specification for Ductile Iron Castings.
 - 10. A564 - Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
 - 11. A743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
 - 12. B584 - Standard Specification for Copper Alloy Sand Castings for General Application.

13. D429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrate.

C. American Water Works Association (AWWA):

1. C110 - Standard for Ductile-Iron and Gray-Iron Fittings 3 Inches through 48 Inches for Water and Other Liquids.
2. C504 - Standard for Rubber-Seated Butterfly Valves.
3. C540 - Standard for Power-Actuating Devices for Valves and Sluice Gates.
4. C550 - Standard for Protective Interior Coatings for Valves and Hydrants.
5. C606 - Standard for Grooved and Shouldered Joints.

D. Compressed Gas Association (CGA):

1. Standard G-4.1 - Cleaning Equipment for Oxygen Service.

E. National Sanitation Foundation (NSF/ANSI):

1. Standard 61 - Drinking Water System Components - Health Effects.

1.03 SYSTEM DESCRIPTION

A. Design Requirements:

1. General Purpose AWWA Butterfly Valves:
 - a. Design Standard: Provide valves designed and manufactured in accordance with AWWA C504.
 - b. Class:
 - 1) Provide butterfly valves conforming to AWWA Class 150B, unless otherwise specified.
 - 2) Provide butterfly valves conforming to AWWA Class 250B in piping systems with test pressure greater than 150 pounds per square inch and less than 250 pounds per square inch:
2. Industrial Class Butterfly Valves:
 - a. Industrial class butterfly valves capable of 150 pounds per square inch leak tight shut off.

B. Usage:

1. Provide and install butterfly valve types as outlined in the Butterfly Valve Application Schedule at the end of this Section.

C. Design Requirements for all Butterfly Valves:

1. Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C540, using the following values:
 - a. Maximum Water Velocity: 16 feet per second with valve fully open.
 - b. Maximum Pressure Differential Across the Closed Valve: Equal to the pressure class designation.

- c. Coefficient for seating and unseating torque, dynamic torque, and bearing friction in accordance with valve manufacturer's published recommendations.
2. Valve Disc: Seat in an angular position of 90 degrees to the pipe axis and rotate an angle of 90 degrees between fully open and fully closed positions.
 - a. Do not supply valves with stops or lugs cast with or mechanically secured to the body of the valve for limiting the disc travel.
3. Unacceptable Thrust Bearings: Do not provide valves with thrust bearings exposed to the fluid in the line and consisting of a metal bearing surface in rubbing contact with an opposing metal bearing surface.

D. Performance Requirements:

1. Tight shutoff at the pressure rating of the valve with pressure applied in either direction.
2. Suitable for the following service conditions:
 - a. Throttling.
 - b. Frequent operation.
 - c. Operation after long periods of inactivity.
 - d. Installation in any position and flow in either direction.

1.04 SUBMITTALS

A. Shop Drawings:

1. Certified drawings and material specifications.
2. For General Purpose AWWA Butterfly Valves, include description of the method of attachment of the disc edge to the valve disc.

B. Product Data: Include manufacturer's published recommendations for seating and unseating torque coefficient, dynamic torque, and bearing friction for calculation of maximum operating torque.

C. Certificates:

1. General Purpose AWWA Butterfly Valves:
 - a. Proof-of-Design Tests: Certified statement that proof-of-design tests were performed and all requirements were successfully met.
 - b. Affidavit of compliance attesting valves provided comply with all provisions of AWWA C504.
2. Interior Epoxy Coatings: Affidavit of compliance attesting that epoxy coatings applied to interior surfaces of butterfly valves comply with all provisions of AWWA C550.
3. Certification, for all valves and coatings in contact with potable water, that the products used are suitable for contact with drinking water in accordance with NSF/ANSI Standard 61.

PART 2 PRODUCTS

2.01 GENERAL PURPOSE AWWA BUTTERFLY VALVES

A. Manufacturers: One of the following or equal:

1. DeZurik.
2. Henry Pratt Company.

B. Valve Body:

1. Material: Cast Iron, ASTM A126, Grade B, or Ductile Iron, ASTM A536, Grade 65-45-12.
2. Body Design:
 - a. Flanged Body Valves:
 - 1) Usage: Comply with limitations specified in the Butterfly Valve Application Schedule.
 - 2) Flanges: ASME/ANSI B16.1 Class 125 flanges for Class 150B valves, ASME/ANSI B16.1 Class 250 flanges for Class 250B valves.
 - b. Mechanical Joint Body Valves:
 - 1) Usage: Comply with limitations specified in the Butterfly Valve Application Schedule.
 - 2) Mechanical Joint Design: Conform to AWWA C110.
 - 3) When mechanical joint body valves are used, incorporate valve into thrust restraint analysis required by Section 15251. Utilize test pressure on one side of valve and zero pressure on the opposite side of the valve. Restrain pipe joints on both sides of valve as determined by thrust analysis calculations.
 - c. Grooved End Body Valves:
 - 1) Usage: Butterfly valves with grooved ends may be used in piping systems specified in the Piping Schedule to have grooved end joints. Comply with additional limitations specified in the Butterfly Valve Application Schedule.
 - 2) Grooved End Joint Design: Conform to AWWA C606.
 - d. Wafer or lug valves are not acceptable.

C. Disc:

1. Material: Cast iron or ductile iron with Type 316 stainless steel edge that matches seat in valve body.
2. Secure valve disc to shaft by means of smooth-sided, taper or dowel pins, Type 316 stainless steel or Monel.
3. Extend pins through full diameter of shaft and mechanically secure in place.

D. Shaft and Bearings:

1. Shaft Design:
 - a. Valves 20-inch and less: One-piece, through disc design.
 - b. Valves greater than 20-inch size: Two-piece, stub shaft design.
2. Shaft Seal: Vee type, chevron design.
3. Shaft Material for Class 150B Valves: Type 316 stainless steel, ASTM A276.

4. Shaft Material for Class 250B Valves: Type 17-4 pH stainless steel, ASTM A564.
5. Shaft Bearings: Self-lubricating sleeve type; Teflon® with stainless steel or fiberglass backing.

E. Seats:

1. Seat Materials:
 - a. In low-pressure air applications: EPDM.
 - b. In all other applications: NBR or natural rubber.
2. For valves 20 inches in nominal size and smaller, bond or vulcanize seat into the valve body.
3. For valves 24 inches in nominal size and larger, retain seats mechanically or by adhesive.
 - a. Mechanical Retainage: Retain seat by a clamping ring with segmented clamping ring locks with adjusting locking screws.
 - 1) Clamping ring, ring locks and adjusting locking screws: Type 316 stainless steel.
 - 2) Provide means to prevent ring locks and screws used to retain seats from loosening due to vibration or cavitation.
 - b. Adhesive Retainage: Inset the seat within a groove in the valve body and retain in place with epoxy injected behind the seat so that the seat expands into the body.
 - c. Do not provide valves with seats retained by snap rings or spring-loaded retainer rings.
4. Resilient Seat: Withstand 75-pound per inch pull when tested in accordance with ASTM D429, Method B.

F. Valve Packing:

1. Valves 4-Inch to 48-Inch Nominal Size: Self-adjusting V-type packing or chevron-type packing.
2. Valves 54-Inch Nominal Size and Larger: Adjustable V-type packing with bronze packing gland or self-adjusting V-type packing.
3. Packing Materials:
 - a. In low-pressure air applications: EPDM.
 - b. In all other applications: NBR.

2.02 BUTTERFLY VALVE ACTUATORS

- A. Motorized actuators are specified in Electrical Specifications.
- B. Manual Actuators for Aboveground Valves, 4 inches in nominal size and smaller for Liquid Service, and 10 inches in nominal size and smaller for Aeration Air Service:
 1. For valves operating at pressures up to and including 250 pounds per square inch, provide hand lever type with locking device so that the valve can be locked in any position with a wing nut.
 - a. Locking Device: Rigid, allowing no vibration or chattering of the valve.
 - b. Hand Lever: 12 inches long, with handgrip.

2. For valves operating at pressures above 250 pounds per square inch, provide totally enclosed worm gear actuator mounted on the valve.
- C. Manual Actuators for Aboveground Valves in nominal sizes and in service applications other than specified above, except for valves 30 inches and larger:
1. For valves operating at pressures up to and including 250 pounds per square inch, provide either a totally enclosed worm gear actuator or a totally enclosed traveling nut actuator mounted on the valve.
 2. For valves operating at pressures above 250 pounds per square inch, provide totally enclosed worm gear actuator mounted on the valve.
- D. Manual Actuators for Aboveground Valves 30 inches in nominal size and larger, all pressures:
1. Provide totally enclosed worm gear actuator mounted on the valve.
- E. Manual Actuators for Buried or Submerged Valves, All Sizes and Pressures:
1. Provide totally enclosed worm gear actuator mounted on the valve.
 2. Actuators for buried or submerged valves shall be hermetically sealed and grease packed.
 3. For buried valves, provide 2-inch square AWWA nut on enclosed actuator.
 4. For buried valves, provide extension stem, valve box, and valve box cover in accordance with Section 15110.
 5. For submerged valves, provide extension stem as indicated on the Drawings.
- F. Position Indication
1. For all aboveground worm gear or traveling nut manual actuators, provide position indication on the actuator enclosure.
- G. Limit Switches: Provide limit switches on manually actuated valves where indicated on the Drawings.
1. Limit Switches: Heavy-duty, industrial grade, oiltight, with not less than two auxiliary contacts.
 2. Rating: Rated for 10 amps, 120 volts AC.
 3. Enclosure: NEMA 4X enclosure, with stainless steel levers and arms. Provide switch with NEMA 7 enclosure when switch is located within areas with NEC Class 1, Division 1 or Class 1, Division 2 designations as indicated on the Drawings.

2.03 COATING

- A. Shop coat interior and exterior metal surfaces of valves, except as follows:
1. Interior machined surfaces.
 2. Surfaces of gaskets and elastomeric seats and stem seals.
 3. Bearing surfaces.
 4. Stainless steel surfaces and components.

- B. Coating Material for Potable Water Applications:
 - 1. Formulate coating material from materials accepted by the Food and Drug Administration, Title 21 of the Code of Federal Regulations on Food Additives.
- C. Field-Applied Exterior Coatings:
 - 1. Additional coating of the valve exterior will be required to match the epoxy or epoxy/polyurethane paint system called for in Section 09960.
 - a. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
 - b. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.
 - 2. Exterior Surfaces of Valves, Actuators, and Accessories:
 - a. Submerged Valves: High solids epoxy per Section 09960.
 - b. Buried Valves: Coal tar epoxy substitute per Section 09960.
 - c. Other Valves: High solids epoxy per Section 09960.
 - 3. Polished and Machined Surfaces: Apply rust-preventive compound.
- D. Interior Surface Coatings:
 - 1. Interior surfaces, except for valves used in low-pressure air service: High solids epoxy per Section 09960.
 - 2. Interior surfaces of valves used in low-pressure air service: High-temperature coating for range of 150 to 350 degrees F, per Section 09960.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install valves with valve shafts horizontal, unless a vertical shaft is required to suit a particular installation, and unless a vertical shaft is indicated on the Drawings.
- B. Install pipe spools or valve spacers in locations where butterfly valve disc travel may be impaired by adjacent pipe lining, pipe fittings, valves, or other equipment.

3.02 BUTTERFLY VALVE APPLICATION SCHEDULE

- A. Acceptable butterfly valve types and body styles are listed in the Butterfly Valve Application Schedule provided at the end of this section. Furnish and install butterfly valves in accordance with this Schedule.

BUTTERFLY VALVE APPLICATION SCHEDULE

Valve Type and Style	Acceptable Applications
General Purpose AWWA Butterfly Valves – Flanged Body Design	Aboveground or submerged in the following service applications only: Acceptable in all service applications except oxygen and ozone service and high-pressure service. May be used in buried applications when required by the specified piping system.
General Purpose AWWA Butterfly Valves – Mechanical Joint Body Design	Buried in the following service applications only: Acceptable in all service applications except oxygen and ozone service and high pressure service.
General Purpose AWWA Butterfly Valves – Lugged Wafer Body Design	Aboveground in the following service applications only: Aeration Air Systems
General Purpose AWWA Butterfly Valves – Wafer (not lugged) Body Design	Not allowed.
General Purpose AWWA Butterfly Valves – Grooved End Body Design	Aboveground, in sizes 20-inch and less, with piping system test pressure less than 100 psi, and in the following service applications only: Acceptable in all service applications, except oxygen and ozone service, where piping for that service is specified in the Piping Schedule to have grooved end joints.
High Pressure Butterfly Valves – Flanged Body Design	Service applications with piping system test pressure greater than 250 psi. Acceptable in aboveground and buried installations.
High Pressure Butterfly Valves – Wafer or Lugged Wafer Body Design	Not allowed.
Industrial Class Butterfly Valves – Lugged Wafer Body Design	Aboveground in the following service applications only: Aeration Air Systems Natural Gas Systems Digester Gas Systems Jacket and Hot Water Systems
Industrial Class Butterfly Valves – Wafer (not lugged) Body Design	Not allowed.
Stainless Steel Butterfly Valves - Lugged Wafer Body Design	Aboveground in the following service applications only: Oxygen Systems Ozone Systems Shall be used in submerged applications where indicated on the Drawings.
Stainless Steel Butterfly Valves – Wafer (not lugged) Body Design	Not allowed.

END OF SECTION

SECTION 15125

GATE VALVES

PART 1 - GENERAL

1.01 SUMMARY

- A. The work of this section consists of furnishing and installing gate valves.
- B. See Section 15100 for additional requirements.

1.02 SUBMITTALS

- A. As specified in Section 01300 and Section 15100.

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
- B. American Society of Mechanical Engineers (ASME)
- C. American Society for Testing and Materials (ASTM)
- D. American Water Works Association (AWWA)
- E. National Science Foundation (NSF 61).

PART 2 - PRODUCTS

2.01 STANDARDS

- A. All products shall comply with the standards referenced in Part 1

2.02 GATE VALVES (2 /12 INCHES AND SMALLER)

- A. Rating: 200 psi WOG.
- B. Type: Rising stem, screw in bonnet, solid wedge disc, handwheel operated.
- C. Connections: Threaded.
- D. Materials: All bronze, UNS 83600, ASTM B62, B505 or B584.
- E. Manufacturers: Jenkins Figure 81OJ; Crane No. 428; or equal.
- F. Exposed Gate Valves 2 ½-inch:
- G. Rating: 200 psi WOG.
- H. Type: Rising stem, O.S. and Y, solid wedge, handwheel operated.
- I. Connections: Flanged, 200 psi WOG.
- J. Materials: Cast iron, UNS 83600, bronze trimmed.
- K. Manufacturers:

L. Jenkins Figure 651A; Crane No. 465 1/2; or equal.

2.03 RESILIENT WEDGE VALVES 3 INCHES AND LARGER

- A. General: Comply with AWWA C509 or C515 except where otherwise specified herein. Valve shall be epoxy lined and coated.
- B. Rating: 200 psi.
- C. Type: Rising stem, OS&Y, handwheel operated except for buried service use non-rising stem with operating nut.
- D. Connections: Flanged.
- E. Manufacturers: Clow Valve Company, Mueller Company, or approved equal.

2.04 SERVICE BOXES FOR VALVES 3 INCHES AND LARGER

- A. Buffalo type cast iron box, with 5-1/4-inch shaft, and cover marked "WATER" or "W".

PART 3 - EXECUTION

3.01 GATE VALVE

- A. Install to the lines as shown on the Drawings and set plumb on a firm base. All foreign matter shall be removed from the interior before installation.

3.02 SERVICE BOXES

- A. Install over the gate valves as shown on the Drawings, with base section centered over valve and resting on well compacted backfill. Set top section to allow equal movement above and below finished grade. Final elevation shall be as shown on the Drawings. Top of base section shall be approximately on line with valve nut and the entire assembly shall be plumb.

END OF SECTION

SECTION 15130

CHECK VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: silent, swing, cushioned swing, and plastic ball check valves.
- B. Related Sections:
 - 1. Section 15110 – General Valve Requirements.
- C. Inclusion of a specific manufacturer's name in the Specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the specifications.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A 48 - Specification for Gray Iron Castings.
 - 2. A 126 - Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 3. A 276 - Specification for Stainless Steel Bars and Shapes.
 - 4. B 582 - Specification for Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet and Strip.
 - 5. B 584 - Specification for Copper Alloy Sand Castings for General Applications.
- B. American Water Works Association (AWWA):
 - 1. C 508 - Standard for Swing-Check Valves for Waterworks Service 2-Inch through 24-Inch NPS.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Check Valves: When not otherwise specified, as indicated on the Drawings, provide check valves suitable for service as follows:
 - a. In either horizontal or vertical position.
 - b. Under pressures equal and less than 150 pounds psi gauge.

PART 2 PRODUCTS

2.01 SWING CHECK VALVES

A. Valves 1/4 Inch through 3 Inches:

1. Manufacturers: One of the following or equal:
 - a. Crane Valve Company, Number 36.
 - b. Lunkenheimer Company, Figure 554Y.
2. Valve Design:
 - a. Threaded joints.
 - b. Y-pattern body with integral seat.
 - c. Hinged disc.
 - d. Access to valve seat for regrinding without disassembly of piping.
3. Materials:
 - a. Body, Cap, Hinge, and Disc: Bronze.

B. Valves 4 Inch through 24 Inches:

1. Manufacturers: One of the following or equal:
 - a. Kennedy, Figure 106LW.
 - b. Mueller Company, Model A-2600.
 - c. M&H, Model 159.
2. Valve Design:
 - a. Conform to AWWA C 508.
 - b. Constructed to permit top entry and removal of internal components without removing the valve.
 - c. Equipped with outside lever and weight.
3. Materials:
 - a. Valve Body, Cover, and Disc: Cast iron, ASTM A 126 Class B.
 - b. Disc Seat and Body Seat Seal:
 - 1) For hot water service: EPDM.
 - 2) For sludge service: Buna N.
 - c. Shaft: Stainless steel.

2.02 CUSHIONED SWING CHECK VALVES

A. Manufacturers: One of the following or equal:

1. GA Industries, Inc., Shockless Swing Check Valve, 250 Series.
2. APCO, Air Cushioned Swing-Check, Series 6000.

B. Valve Design:

1. Counter-weighted.
2. Rubber seated and drip-tight.
3. Pneumatic dampening chambers with adjustment for closing speed.
4. Design for Class 250 psi for the Tertiary Effluent Pump Station.

C. Materials:

1. Valve Body, Cover, and Disc: Cast iron, ASTM A 126, Class B.
2. Disc seat: Buna N.
3. Shaft: Stainless steel.

4. Cushion Cylinder: Corrosion-resistant metal/air cushion side mounded.
5. Disc Ring Seat: Bronze.
6. Seat Pins and Lock Screws: Stainless steel.

2.03 SILENT CHECK VALVE

- A. Rating: 200 psi through 12-inch, 150 psi above 12-inch size.
- B. Headloss: Not more than 2.5 ft. at 8 ft./sec. velocity.
- C. Type: Center guided plug with spring operated shut-off.
- D. Connections: Flanged, 125-pound ANSI. If connecting flanges are not full-face metal flanges, provide intermediate flanges where required to retain valve seat.
- E. Materials: Cast iron, bronze trim, stainless steel spring.
- F. Manufacturers: APCO Series 600; or equal.

2.04 PLASTIC BALL CHECK VALVES

- A. Manufacturers: One of the following or equal:
 1. Chemtrol Division of Nibco.
 2. R. G. Sloane Company, Inc.
- B. Valves: Ball type.
 1. Polyvinyl chloride.
 2. Double or single union-type end connections.
 3. Seals: Viton.
- C. Manufacturers: One of the following or equal:
 1. Crane Company, Crane Valve Group, Duo Chek Check Valves.
 2. Techno Corporation, equivalent product.
- D. Valve Design:
 1. Spring-assisted dual valve plates with metal hinge. Springs designed to close valve plates upon flow reversal.
 2. Replaceable elastomeric seal secured to valve plates with clamp plates and fasteners.
 3. Valve seats integral with valve body. Eliminate leakage when valve plates are fully closed with elastomeric seal in full contact with valve seat.
 4. Flanged ANSI Class 125 end connections.
 5. Stops on valve shaft which prevent valve plates from opening more than 90 degrees from closed position.
- E. Materials:
 1. Body: Cast iron.
 2. Valve Plates: Bronze.
 3. Seal: Buna N EPDM Viton.
 4. Trim: Type 316 stainless steel.
 5. Spring: Type 316 stainless steel.

PART 3 EXECUTION

3.01 ADJUSTING

- A. Adjust cushioned swing check valves in the field by means of external adjustment devices to minimize pressure surges.
- B. Adjust weight on swing check valves to affect proper closing action on equipment shutdown.

END OF SECTION

SECTION 15150

VACUUM AND AIR RELEASE VALVES

PART 1 - GENERAL

1.01 SUMMARY

- A. The work of this section consists of furnishing and installing vacuum, combination air vacuum, and air release valves as shown on the Drawings.
- B. See Section 15100 for additional requirements.

1.02 SUBMITTALS

- A. As specified in Section 01300 and Section 15100.

1.03 REFERENCES

- A. American National Standards Institute (ANSI)
- B. American Society of Mechanical Engineers (ASME)
- C. American Society for Testing and Materials (ASTM)
- D. American Water Works Association (AWWA)
- E. National Science Foundation (NSF 61).

PART 2 - PRODUCTS

2.01 STANDARDS

- A. All products shall comply with the standards referenced in Part 1

2.02 COMBINATION AIR VACUUM VALVES

- A. Function: Exhausts large volumes of air during pipeline filling, releases accumulated air under pressure and allows air back in when pipeline pressure drops below atmospheric pressure.
- B. Provide slow closing Surge Check below air valve consisting of a globe style, sliding disc spring return valve.
- C. Materials: Cast or ductile iron body; stainless steel float.
- D. Pressure Rating: 150 psi.
- E. Manufacturers: Apco Series 140C or 150C; equivalent by Valmatic; or equal

2.03 VERTICAL TURBINE PUMP AIR/VACUUM RELIEF VALVES

- A. Air/vacuum relief valves installed on vertical turbine pump discharge piping (for example, the backwash water return pumps) shall vent large quantities of air through the discharge orifice when the pump starts, close tight when liquid enters,

and permit large quantities of air to re-enter through the orifice when the pump stops to prevent vacuum formation. Throttling devices shall be provided to control the rate of air exhaust and establish back pressure on the rising suction column of water

- B. Air/vacuum relief valves shall have a separately attached air release valve for releasing small quantities of entrapped air.
- C. Valves 3-inch and smaller shall be fitted with a water diffuser to control the surge of water into the valve body.

PART 3 - EXECUTION

3.01 VALVE

- A. Install to the lines as shown on the Drawings and set plumb on a firm base. All foreign matter shall be removed from the interior before installation.

3.02 SERVICE BOXES

- A. Install over the valves as shown on the Drawings, with base section centered over valve and resting on well compacted backfill. Set top section to allow equal movement above and below finished grade. Final elevation shall be as shown on the Drawings.

END OF SECTION

SECTION 15190

MISCELLANEOUS VALVES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Cocks.
 - 2. Corporation stops.
 - 3. Curb stops.
- B. Related Sections:
 - 1. Section 15110 - Valves.
- C. Inclusion of a specific manufacturer's name in the Specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the Specifications.

PART 2 PRODUCTS

2.01 CORPORATION STOPS

- A. In Accordance with AWWA C 800: Manufacturers: One of the following or equal:
 - 1. Ford.
 - 2. Mueller Company.

2.02 CURB STOPS

- A. Manufacturers: One of the following or equal:
 - 1. Ford.
 - 2. Mueller Company.
- B. Description: Round way solid tee head stops.

2.03 COCKS

- A. Gauge Cock: Manufacturers: One of the following or equal:
 - 1. Lunkenheimer Company, Figure 1178 or Figure 1180.
- B. Air Cock: Manufacturers: One of the following or equal:
 - 1. Whitey Research Tool Company, Model B-42S4.
 - 2. Hoke Inc., 7122G4B.
- C. Plug Cock Manufacturers: One of the following or equal:
 - 1. Lunkenheimer Company, Figure 454.

D. Design: Plug cocks: Bronze, straightway pattern complete with lever.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install as specified in Section 15110.

END OF SECTION

SECTION 15200
PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Piping specialties including:
1. Flexible rubber connections.
 2. Rubber expansion joints.
 3. Expansion joints.
 4. Vibration control joints.
 5. Pipe saddles.
 6. Tapping sleeves.
 7. Camlock
- B. Related Sections:
1. Section 15052 - Basic Piping Materials and Methods.
- C. Inclusion of a specific manufacturer's name in the specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the specifications.

1.02 REFERENCES

- A. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME).
- B. American National Standards Institute/American Water Works Association (ANSI/AWWA):
1. ANSI/AWWA C153/A21.53 - Ductile-iron compact fittings.
 2. ANSI/AWWA C111/A21.11 - Rubber gasket joints for ductile-iron and gray-iron pressure pipe and fittings.
 3. ANSI/AWWA C110/A21.10 - Ductile-iron and gray-iron fittings.
 4. ANSI/AWWA C213 - Fusion-bonded epoxy coatings and linings for steel water pipelines.
 5. ANSI/AWWA C151/A21.51 - Ductile-iron pipe, centrifugally cast.
- C. American Society for Testing and Materials (ASTM).
1. ASTM A148 - Specification for steel castings, high-strength, for structural purposes.
 2. ASTM A536 - Specification for ductile iron castings.

D. Society of Automotive Engineers (SAE).

1.03 DELIVERY, STORAGE, AND HANDLING

A. Expansion Joints and Vibration Control Joints:

1. Protect joint bellows and sliding surfaces against damage during packing, shipping, and installation, and also during pressure test.
2. Lock expansion joints against movement until pressure tests are completed.
3. Replace damaged expansion joints with new and undamaged expansion joints.

PART 2 PRODUCTS

2.01 NOT USED

2.02 RUBBER EXPANSION JOINTS

A. Manufacturers: One of the following or equal:

1. Mercer Rubber Company.
2. Red Valve Company, Inc.

B. Provide rubber expansion joints complete with control units and split retaining rings.

C. Design:

1. Material: Neoprene rubber, reinforced with embedded steel rings, and a strong synthetic fabric.
2. Expansion Rings, Suitable for Pressures of at Least 125 Pounds per Square Inch Gauge, Except as Follows:
 - a. Expansion joints in pump suction piping and where indicated on the Drawings suitable for minimum 150 pounds per square inch gauge, pressure and minimum 30 inches mercury vacuum.

D. Retaining rings: 316 stainless steel.

E. Ends of expansion joints, 150 pound ANSI flanges with drilling to match that of the piping.

F. Provide standard configuration on reducers (concentric or eccentric) as required.

G. Provide filled arches with a smooth flow path to prevent accumulation of solids.

H. Control rods shall be 316 stainless steel.

I. Rubber Expansion Joints for Blowers: Butyl type rubber formulated for service application and for maximum temperature of 250 degrees F, suitable for minimum 40 pounds per square inch gauge pressure, and minimum 15 inches mercury vacuum.

- J. Provide a UV coating for the expansion joints that are exposed to sunlight. The coating shall be Clifton adhesives PC 1091 or equal.

2.03 VIBRATION CONTROL JOINTS

A. Manufacturers:

- 1. Braided Bronze Flexible Vibration Joints 2 Inches and Less in Size: One of the following or equal:
 - a. Flexonics, Inc., Type Vibra Sorber.
 - b. Flex-Weld, Inc, Keflex, Type KFCB.
- 2. Flexible Vibration Joints Larger Than 2 Inches: One of the following or equal:
 - a. Flexonics, Inc., Type TCS.
 - b. Flex-Weld, Inc., Keflex, Series 151 TR 1215.
- 3. Corrugated Stainless Steel with Stainless Steel Braid Flexible Vibration Joints: One of the following or equal:
 - a. Flexonics, Inc., Type FCS.
 - b. Flex Weld, Inc., Keflex, Type USFNSS 31.

B. Design:

- 1. Flexible Vibration Joints 2 Inches and Smaller: Braided bronze, suitable for pressures of not less than 250 pounds per square inch gauge.
- 2. Flexible Vibration Joints Larger Than 2 Inches: Flexible bellows type, suitable for pressures of not less than 150 pounds per square inch gauge, at 70 degrees F, except as follows:
 - a. Provide vibration joints in piping subject to test pressures higher than 150 pounds per square inch gauge, suitable for such higher pressures.
 - b. Bellows: Stainless steel, equipped with a stainless steel liner.
 - c. Ends: ANSI Class 150 flanges.
- 3. Vibration Joints in High Pressure Air Piping and in Digester Gas Piping: Corrugated Type 316 stainless steel with stainless steel braid, suitable for pressures of not less than 150 pounds per square inch gauge.
 - a. Ends: ANSI Class 150 flanges.

- C. Protection: Protect vibration absorbers against end loading and torsional stresses by anchoring attached piping.

2.04 PIPE SADDLES

A. Manufacturers: One of the following or equal:

- 1. BTR Inc./Smith-Blair, Inc., Style 317.
- 2. Romac Industries, Inc., Style 202S.

B. Materials:

- 1. Pipe Saddles: Ductile iron.
 - a. Straps, Bolts, and Nuts: Type 304 stainless steel with Teflon coating on nuts.
 - b. Gaskets: Rubber.

2.05 TAPPING SLEEVES

A. Manufacturers: One of the following or equal:

1. BTR Inc./Smith-Blair, Inc., Style 622.
2. Romac Industries, Inc., Style FTS 420.

B. Materials:

1. Tapping Sleeves: Steel construction.
2. Bolts and Nuts: Type 304 stainless steel.
3. Nuts: Teflon coated.
4. Gaskets: Rubber.
 - a. Size of Tapped Boss: As indicated on the Drawings.

2.06 CAMLOCK

- ### A. Camlock Quick Disconnect shall be stainless steel and suitable for potable water or food grade applications. Disconnects shall use a minimum of two cam action locking levers to complete connections. Disconnect dimensions shall comply with the specifications of MIL-C- 27487. Provide a dust cap of the same material as the quick disconnect for each disconnect. Quick disconnects shall be a F-Adapter (Adapter x Male NPT Thread) by PT Coupling Company, OPW, or approved equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Expansion and Vibration Control Joints:

1. Prevent equipment vibration transmitted through piping system, and prevent damaging stresses due to normal expansion and contraction with temperature changes in piping and connected equipment.
 - a. Where anticipated expansion is greater than can be absorbed by the normal piping configuration, install loops, bends, and expansion joints as indicated on the Drawings, to absorb excess expansion.
2. Install expansion joints so as to allow 2-1/4-inch expansion per 100 linear feet of piping.
3. Where possible, install expansion joints adjacent to an anchor, and provide one concentric guide on piping within 12 pipe diameters, but not more than 5 feet, from the end of the joint opposite the anchor.
 - a. Locate a similar guide approximately 30 diameters but not more than 10 feet from the first.
4. For expansion joints not installed adjacent to an anchor, provide two concentric guides similarly located at each end of the joint.
 - a. Provide control rods and additional guides where required and where indicated on the Drawings, but at no greater intervals than recommended by the joint manufacturer in published instructions.
 - b. Space intermediate supports a minimum of 10 feet, and tack weld the protective saddles to the pipe.

- B. Not used
- C. Vibration Control Joints:
 - 1. For piping running to or from mechanical equipment, provide flexible vibration joint at equipment connection.
- D. Pipe Saddles:
 - 1. Coat threads on bolts with anti-gall coating prior to installation.
- E. Tapping Sleeves:
 - 1. Coat threads on bolts with anti-gall coating prior to installation.
- F. Process Control Spray Nozzles:
 - 1. Install nozzles as shown on the Drawings, so that spray is straight down and fan spray pattern is parallel to utility water supply line.

3.02 FIELD QUALITY CONTROL

- A. Testing: Field test gauges with a calibrated test gauge, in the presence of ENGINEER.

END OF SECTION

SECTION 15450

EMERGENCY EYEWASH/SHOWER AND HOT WATER HEATER EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

- A. Section Includes: Emergency shower and eyewash (20-EWS-900).
- B. Inclusion of a specific manufacturer's name in the Specifications does not mean that the specific manufacturer's standard product will be acceptable. Specified manufacturer's or other manufacturer's standard product shall be modified as required to meet the specifications.
- C. Related Sections:
 - 1. Section 15050 - Basic Mechanical Materials and Methods.
 - 2. Section 16050 - Basic Electrical Materials and Methods.

1.02 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. Z358.1 - Emergency Eyewash And Shower Equipment.
 - 2. Z535.1 - Safety Color Code.
- B. NIOSH Schedule 13F.

1.03 SUBMITTALS

- A. Shop Drawings.
- B. Product Data:
 - 1. Submit manufacturer's product literature information for products specified.
 - 2. Manufacturer's Installation Instructions.
- C. Operation and Maintenance Data.
- D. Operating and Maintenance Information for Safety Detectors and Breathing Apparatus: 6 complete sets.
- E. Warranty.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Show evidence that the firm has been engaged in producing such materials and products for at least 5 years and that the product submitted has a satisfactory performance record of at least 5 years.

- B. Installer Qualifications: Installer shall have 3 years experience in installing these materials for similar projects and shall be approved by the manufacturer prior to bidding of the project.
- C. Regulatory Requirements:
 - 1. As applicable, equipment of this Section shall comply with requirements of public agencies of the state where the project is located including OSHA, Cal-OSHA, Underwriters Laboratories, NFPA, and ASME.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver to the job site in manufacturer's original containers.
- B. Delivery: After wet operations in building are completed.
- C. Storage and Protection: Store materials in original, unopened containers in compliance with manufacturer's printed instructions.
- D. Keep materials dry until ready for use. Keep packages of material off the ground, under cover, and away from sweating walls and other damp surfaces.
- E. Protect finished surfaces from soiling and damage during handling and installation. Keep covered with a protective covering.

PART 2 PRODUCTS

2.01 EMERGENCY SHOWERS AND EYE WASHES

- A. General Design Requirements:
 - 1. Combination Unit Emergency Shower with Eyewash or Eye/Face Wash:
 - a. Floor mounted fixture consisting of pipe standard, shower head assembly, and eyewash assembly.
 - b. Provide stanchion and floor flange, with interconnecting piping.
 - 2. Shower Head Flow: 30.0 GPM.
 - 3. Eyewash or Eye/Face Wash Flow: 5.0 GPM flow, minimum.
 - 4. Provide with manufacturer's standard corrosive resistive coating for steel pipe standards.
 - 5. Meet or exceed all requirements of ANSI Z358.1.
 - 6. Provide ANSI compliant identification sign and markings.
- B. Combination Unit Emergency Shower and Eye/Face Wash:
 - 1. Manufacturers: One of the following or equal:
 - a. Haws:
 - 1) No. 8309.
 - 2) No. 8317.
 - b. Fisher Scientific, No. 91-589.
 - c. Scientific Products, Model Number 1395 10.
 - d. Bradley, S19-310AC.
 - 2. Pipe Standard:

- a. 1-1/4-inch hot-dip galvanized steel pipe, and fittings with interconnecting piping, stanchion and 9-inch diameter floor flange.
 - b. Corrosion Protection: Provide Haws CRP green pipe coating or equal, in corrosive environments.
3. Shower Head:
- a. Material and Size: ABS plastic, 10-inch diameter.
 - b. Valve and Actuator: Stay open chrome plated brass ball valve equipped with stainless steel ball and stem operated by a rigid stainless steel pull rod.
4. Eye/Face Wash Receptor:
- a. Valve and Actuator: Stay open chrome plated brass ball valve with stainless steel ball and stem operated by a stainless steel push handle and foot treadle.
 - b. Spray Heads: ABS plastic twin soft-flow eye/face wash type heads, with integral flip top dust covers releasing with water pressure.
 - c. Receptor Bowl: Stainless steel with No. 7 bright finish on exterior; 11 inches diameter, with chrome-plated fixtures.
5. Supply: 1-1/4-inch IPS.
6. Waste: 1-1/4-inch IPS.

C. Safety Shower Tester:

- 1. Manufacturers: One of the following or equal:
 - a. Haws, No. 9010.
 - b. Fisher Scientific, No. 14-294-8.
- 2. Kit includes: 5-gallon plastic bucket, 7-foot long watertight 12-gallon translucent vinyl plastic bag for attaching over drench shower head, and testing record card. Bag shall have drawstring at top and be hemmed at bottom.

D. Safety Shower Tepid Water Supply System:

- 1. Manufacturers: One of the following or equal:
 - a. Haws.
- 2. General Requirements:
 - a. Provide one Tepid Water System for each safety shower unit or group of safety shower units mounted within 100 feet of each other.
 - b. Tepid water System to provide 20 gpm of water for a period of at least 15 minutes at a delivery temperature of 80 to 85 degrees Fahrenheit.

2.02 HOT WATER HEATER AND WATER EXPANSION TANKS

- A. Emergency Shower Tank Water Heater and Mixing Valve Assembly: Emergency shower tank water heater with mixing valve shall be designed to provide potable tepid water to emergency showers and eyewash assemblies, and shall include a minimum 120 gallon tank, electric heater, controls, mixing valve, temperature and pressure relief valve, air vent valve, drain valve, operating thermostat, and unit-mounted copper piping for cold and hot water between the tank and mixing valve. Minimum design pressure shall be 150 psi. Maximum pressure drop at 23 gpm shall be 8 psi. Voltage and phase for the electric heater shall match that shown on the electrical Drawings for each separate unit. Minimum heater size is 1500 watts; increase wattage of heater as required to match voltage and phase indicated on

Drawings and manufacturer's requirements. Heating element shall be copper sheathed. Each emergency shower water heater assembly shall be capable of providing 85 degree F water at a minimum of 23 gpm for a minimum of 30 minutes. Tank shall be insulated and covered with a durable protective jacket. Cold water inlet connection size shall be 1.5-inch and tepid water outlet size shall be 1.25-inch. Emergency shower water heater and mixing valve assemblies shall be Hubbell EMV, Haws, or approved equal.

- B. Water Expansion Tanks: Water expansion tanks shall provide for the pressurized expansion of potable hot and cold water. Tanks shall be the fixed bladder type, made to ASME Boiler and Pressure Vessel Code Section VII construction, 150 psi operating pressure, carbon steel shell, stainless steel or brass system connection, FDA approved butyl bladder, standard tire charging valve connection, and prime painted exterior. Expansion tanks shall come pre-charged. Tank wetted surfaces contacted by consumable water shall be lead restriction compliant (less than one quarter of one percent of lead by weight). Tank volume shall be as shown on the Drawings. If volume is not shown on the Drawings, provide a tank sized for the use shown and a minimum volume of 15 gallons. Water expansion tanks shall be by Watts, Amtrol, or approved equal.

2.03 Provide ANSI compliant identification sign and markings

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturers' recommendations.
- B. Install fixed equipment in accordance with manufacturer's instructions.
- C. Plumbing and mechanical work shall be in accordance with Section 15050.
- D. Electrical connections and distribution shall be in accordance with Electrical Specifications.

3.02 PROTECTION

- A. Repair or replace defective equipment with new.

END OF SECTION

SECTION 16001

ELECTRICAL – GENERAL PROVISIONS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Division 16, Electrical covers the work necessary for the complete electrical systems for the Pad D Standby Well Project (Project). Furnish all materials, labor, and equipment as specified herein, in other Division 16 Specification Sections as listed below, and the Drawings for a complete, operational, tested, and commissioned electrical system.
- B. The requirements of Division 16, Electrical in their entirety apply to all electrical work and equipment furnished on this project whether furnished or specified under this or other Divisions of these Specifications.
- C. The work shall include furnishing, installing and testing the equipment and materials detailed in the following Sections. Where differences exist between the specific equipment Specification Sections of Division 16 and this Section, the specific equipment Specifications shall govern.
 - 1. 16001 – Electrical - General Provisions
 - 2. 16062 – Grounding System
 - 3. 16120 – Conductors and Cables (600 Volt Maximum)
 - 4. 16130 – Raceways, Boxes, Fittings and Supports
 - 5. 16135 – Underground Raceway System
 - 6. 16141 – Wiring Devices
 - 7. 16145 – Miscellaneous Electrical Equipment
 - 8. 16222 – Low Voltage Motors
 - 9. 16230 – Standby Diesel Engine-Generator
 - 10. 16272 – Dry Type Transformers
 - 11. 16440 – Switchboards
 - 12. 16442 – Motor Control Center
 - 13. 16448 – Panelboards
 - 14. 16500 – Lighting System
- D. The work shall include the following:
 - 1. Furnishing and installing complete operational systems functionally in accordance with the intent of these Contract Documents as specified in these Specifications and shown on the Drawings.
 - 2. Coordinating the details of equipment layouts and construction for all Specification Divisions which affect the work covered under Division 16, Electrical.

3. Furnishing and installing all incidental items not specifically shown or specified, but which are required by good practice and standards of the industry to provide complete functional systems.
 4. Coordination and work associated with equipment provided under technical Divisions 2 through 15 of these Specifications including but not limited to: mechanical systems packaged with electrical equipment, motor operated valves with integral controls, pump motors with motor protection controls, field instrumentation.
 5. Coordination and work associated with Division 13 – Process and Instrumentation, for installation of plant control system including but not limited to: control networks and media converters, computers, control panels, conduit, wire, and terminations as required.
 6. Conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other technical sections of these Specifications.
 7. Conduit, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators, and control panels; lightning and surge protection equipment wiring at process instrumentation transmitters and analyzers; instrumentation disconnect switches; installation of vendor furnished cables specified under other Divisions.
 8. Installation motor control equipment, accessories, and appurtenances furnished under other Divisions.
 9. Certain pieces of laboratory or process equipment (e.g., still, water-baths, fume hood, etc) are furnished unassembled. Perform all electrical work necessary to make this equipment operative.
 10. Seismic calculations, anchoring, and restraints for electrical equipment and systems requiring such restraints as required under **Section 01190**.
 11. Short Circuit Study, System Protective Device Coordination Analysis, Arc Flash Calculations, and other electrical system modeling work.
 12. Testing of the electrical equipment and making final settings for the electrical protective devices.
- E. Each bidder shall, before preparing their proposal, visit the facility in which work is to be performed and inspect carefully the present conditions. The submission of a proposal by a bidder shall be considered evidence that the bidder has visited the facility; noted the locations and conditions under which the work will be performed; and incorporated these locations and conditions into their proposal with respect to the factors governing the work.
- F. Sequencing and Scheduling
1. Coordinate electrical equipment installation with other components.
 2. Arrange for chases, slots and openings in the structures during the progress of construction to allow for the electrical installation.
 3. Coordinate installing required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

4. Sequence, coordinate, and integrate the installation of electrical materials and equipment for efficient flow of the work.
5. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

1.02 RELATED WORK

- A. Section 01612 – Seismic Design Criteria
- B. Section 01614 – Wind Design Criteria
- C. All trenching, drilling, backfill, compaction, and surface restoration shall be as indicated on the Drawings and as required under Division 2 of these Specifications.
- D. All concrete and reinforcement shall be as indicated on the Drawings and as required in Division 3 of these Specifications. However, the responsibility of furnishing and installing the underground systems shall be included under this Section.
- E. Process equipment requiring electrical work are specified in the other Technical Sections of these Specifications: Divisions 2 through 15.
- F. Instrumentation and Controls are included in Division 13.

1.03 SUBMITTALS

- A. General
 1. Submit manufacturers' descriptive information and shop drawings for all equipment, material, and devices furnished under Division 16 Sections. Prepare and format submittals in accordance with Section 01300 and as specified herein
 2. Mark submittals to clearly identify proposed equipment including accessories, options, and features and to exclude information, products, options, or parts not applicable to the Project.
 3. If the equipment installed during construction does not match the equipment that was approved by the Engineer during submittal review, the Contractor shall resubmit all documentation related to the installed equipment as specified. Should the unapproved equipment be found not to be in conformance with the Contract Documents, it shall be removed and replaced with suitable equipment at the Contractor's expense.
 4. Review of submittal information by the Engineer shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications, unless he has in writing at time of submission requested and received written approval from the City for specific deviations. Review of submittal information shall not relieve the Contractor from responsibility for errors and omissions in shop drawings or literature.
 5. Where submittal documents are submitted in electronic format, the engineer reserves the right to request a hard copy of the package for review of complex drawings or shop drawing information. For large electronic packages over 50 pages in length, provide suitable electronic indexing or book marking to match the table of contents, tabulations, drawings, individual product material catalog cut sheets or other documents types provided. Indexing or bookmarking shall be used to facilitate navigation and review of the document. Large electronic

packages submitted without such indexing shall be returned to the Contractor unreviewed.

6. Check information and shop drawings for accuracy prior to submittal. Stamp shop drawings with the date checked and a statement signed by the Contractor indicating that the information and shop drawings conform to the requirements of the Contract Documents. This statement shall also list all exceptions incorporated into the Contract Documents. Shop drawings without this signed and dated statement shall be returned unreviewed, marked NOT APPROVED.
7. The Engineer's review of the submittal information shall only be for general conformance with the design concept and the information given in the Contract Documents. The Engineer's review does not relieve the Contractor from responsibility for errors or omissions in their submittal; Contractor's compliance with the Plans and Specifications, applicable laws, codes and regulations; or the Contractor's responsibility of addressing any deviations from the Contract Documents.
8. Review of a specific item in a submittal shall not constitute review of an assembly of which the item is a component.
9. The Contractor is responsible for: confirming and correlating all quantities, dimensions, details, tolerances, and clearances; for all information that pertains to the fabrication processes or to the means, methods, techniques, sequences and procedures of construction; coordination of the Work with that of all other trades and for performing the Work in a safe and satisfactory manner. All dimensions shall be field verified at the job site and coordinated with the work of all other trades performing work under this Contract.
10. Short Circuit Study, System Protective Device Coordination Analysis, and Arc Flash Calculations.
11. Material shall not be ordered or shipped until the submittal information or shop drawings have been approved. No material shall be ordered or shop work started if shop drawings are marked "APPROVED AS NOTED - CONFIRM," "APPROVED AS NOTED - RESUBMIT" or "NOT APPROVED."

B. Seismic requirements:

1. Submit seismic mounting and anchorage calculations for electrical equipment as follows:
 - a. Where specifically called for in the specific Technical Sections of Division 16.
 - b. Where required under the requirements of Section 01190.
2. Submit an itemized list 90 days following Notice To Proceed indicating all systems and equipment for which seismic anchoring will be provided under Contract. List shall include equipment designation, raceway identifier, cable tray tag, etc. as shown on the Contract Documents. List shall also include the Electrical Drawing number where the specific anchoring system is to be located.
3. Prepare and submit seismic anchorage and mounting calculations as specified conforming to the requirements and technical criteria per Section 01190.
4. Installation of equipment shall not proceed until mounting and anchoring calculations have been submitted and approved.

C. Operation and Maintenance Data

1. Submit operations and maintenance data for equipment furnished under this Division, in accordance with Section 01782. The manuals shall be prepared specifically for this Project. Include catalog data sheets, layout drawings, control drawings, equipment lists, functional descriptions, and bills of materials or parts lists with replacement part numbers.
2. Manual provided under this Section shall consist of the individual O&M information provided under the other technical sections of Division 16. Coordinate and organize this information into a single, comprehensive, electrical system O&M manual subject to the specified requirements.
3. Manuals shall include the following as a minimum:
 - a. A comprehensive index of the major equipment provided.
 - b. A functional description of the entire system with references to the individual system elements, schematic drawings, and instructions.
 - c. A complete "As-Built" set of approved shop drawings.
 - d. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
 - e. A table listing sorted by equipment designation of the "as left" settings for all control, timing, and protective relays defining all timing, alarm, and trip setpoints.
 - f. System schematic drawings "As-Built," illustrating all components electric connections of the systems supplied under this Section.
 - g. Detailed service, maintenance and operation instructions for each item supplied.
 - h. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
 - i. Complete parts list with stock numbers, including spare parts.
4. Incorporate final versions of electrical analyses reports and studies as specified herein.
5. Incorporate final versions of electrical test reports as specified herein.

1.04 STANDARDS, CODES, PERMITS, AND REGULATIONS

- A. Electrical equipment, materials and installation shall comply with the National Electrical Code (NEC, NFPA 70) 2017 Edition, including the California Electrical Code (CEC-2019) Amendments. All references to the NEC included in the Contract Documents shall be interpreted to be referenced to this version with the California Amendments as specified.
- B. Perform work; furnish, install, and test materials and equipment in full accordance with applicable rules, regulations, requirements, and specifications of the following. Where reference is made to one of the standards, the revision in effect at the time of bid opening shall apply.
 1. Local Laws and Ordinances
 2. State and Federal Laws
 3. State Building Codes

4. State Fire Marshal
 5. California Code of Regulations
 - a. Title 24, Part 3 – California Electrical Code (NEC with California Amendments))
 6. California Division of Occupational Safety and Health (DOSH), Cal OSHA
 7. Institute of Electrical and Electronic Engineers (IEEE)
 - a. Standard C2: National Electrical Safety Code (NESC)
 8. National Electrical Contractors Association (NECA)
 - a. National Electrical Installation Standards (NEIS)
 9. National Electrical Manufacturer’s Association (NEMA)
 - a. NEMA Publication 250: Enclosures for Electrical Equipment (1000 Volts Maximum)
 10. National Fire Protection Association:
 - a. NFPA 70E: Standard for Electrical Safety in the Workplace
 11. InterNational Electrical Testing Association, Inc (NETA)
 - a. Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems
 12. Pacific Gas and Electric Company (PG&E), Electric & Gas Service Requirements (Green Book)
- C. Where conflicts may occur between the above items the more stringent applicable requirements shall apply. 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 applicable codes and standards.
- D. Underwriters Laboratories (UL) listing is required for all equipment and materials where such listing is offered by the Underwriters Laboratories. Safety labeling and listing by other organizations, such as ETL Testing Laboratories, Factory Mutual (FM) or other nationally recognized entity may be substituted for UL labeling and listing if approved by the Engineer. Provide UL service entrance labels for all equipment required by the NEC to have such labels.
- E. Equipment, materials and installation shall comply with the requirements of the local authority having jurisdiction. Obtain all permits and pay all fees required by any governmental agency or utility having jurisdiction over the work. Coordinate and arrange all inspections required by these agencies. On completion of the work, submit satisfactory evidence to the Engineer that the work is acceptable to the regulatory authorities having jurisdiction.

1.05 INTERPRETATION OF CONTRACT DOCUMENTS

- A. The Contract Drawings indicate the extent, general location, and arrangement of equipment. Duct bank and conduit runs are diagrammatic and may not show the exact locations for installation. Verify locations of conduit stub-ups based upon conduit entry space of equipment furnished from the manufacturer’s certified shop drawings, by inspection of the actual equipment to be installed, and coordinated with

other trades. Stub-up conduits as near as possible to equipment terminal enclosures.

- B. Except where dimensions are shown, the locations of equipment, fixtures, outlets and similar devices shown on the Drawings are approximate only. Exact locations shall be determined by the Contractor and approved by the Engineer. Obtain information relevant to the placing of electrical work including final equipment dimensions and installation criteria. In case of any interference with other work, proceed as directed by the Engineer and furnish all labor and materials necessary to complete the work in an approved manner.
- C. Unless otherwise approved by the Engineer, conduits shown exposed on the Drawings shall be installed surface mounted or suspended as applicable; conduit shown concealed on the Drawings shall be installed in walls, floor slabs, or ceilings as applicable.
- D. Install each 3 phase circuit in a separate conduit unless otherwise shown on the Drawings.
- E. Conduit routing, layouts, or "home runs" shown on the Drawings are not intended to show the number of fittings or other installation details. Furnish all labor and materials necessary to install and place in satisfactory operation all power, lighting and other electrical systems shown.
- F. Verify the exact locations and mounting heights of lighting fixtures, switches and receptacles prior to installation.
- G. Number and size of wires which shall be installed in runs of conduit where not shown on the Drawings shall be determined from the one line, schematics, connection, interconnection, and control diagrams of the actual equipment furnished.
- H. Raceways and conductors for lighting, switches, receptacles and other miscellaneous low voltage power and signal systems specified are not shown on the Drawings. Raceways and conductors shall be provided as required for a complete and operating system. Homeruns, as shown on the Drawings, are to assist the Contractor in identifying raceways to be run exposed and raceways to be run concealed. Raceways shall be installed concealed in all finished spaces and may be installed exposed or concealed in all process spaces. Raceways installed exposed shall be near the ceiling or along walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes hoists, monorails, equipment hatches, doors, windows, etc.
- I. Modifications or Substitution of Equipment
 - 1. Where a specific material or equipment is listed in the Specifications or on the Drawings, it is understood and construed as meaning to indicate a standard of quality. Unless specifically noted otherwise, such listing is not intended in any way to bar the use of any material or equipment that is of equal or better quality.
 - 2. The Electrical Drawings have been prepared on the basis of the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional work or material may be required to accommodate the second named equipment into the project. The Contractor desiring to use the second named equipment or any equal equipment is responsible for all costs, including

cost of any engineering, material, or installation, incurred by using other than the first named equipment.

3. Likewise, redesign of electrical or mechanical work, which is required due to the Contractor's use of an alternate item, arrangement of equipment and/or layout other than that shown on the Contract Documents, shall be performed at the Contractor's expense. Contractor shall pay for all such changes including protective devices, bus ratings, conduit, wire, building modifications, etc.
4. Contractor shall be responsible for preparing any required engineering documents specified under Division 16. Where indicated, submit documents stamped and signed by a Professional Electrical Engineer currently registered in the State of California.
5. Changes from the layout shown to facilitate use of alternate equipment shall not be a basis for additional payment; neither shall changes in electrical controls or wiring or piping caused by the use of second named or equal equipment be a basis for additional payment.

1.06 PROJECT/SITE REQUIREMENTS

- A. Elevation: Equipment shall be designed to operate at a ground elevation of approximately 50 feet above mean sea level.
- B. Temperature: Equipment located in exterior locations shall be suitable for operation at temperatures from 0° to +104° C degrees ambient.
- C. Relative Humidity: Equipment located in air conditioned spaces shall be suitable for 0 to 95 percent relative, non-condensing humidity. All other equipment shall be suitable for 0 to 100 percent relative, condensing humidity.
- D. Provide equipment and devices suitable for continuous operation at the temperatures and elevations at the site and at the facility installation locations shown on the Drawings.
 1. Provide equipment capable of continuous operation at the required rated output shown on the Contract Documents at the specified site conditions.
 2. Provide any additional equipment such as passive thermal cooling, insulation, sunshades, heating, cooling equipment, or other means so that the rated performance requirements can be met. Such equipment shall be provided at no additional cost to the City.
 3. Provide suitability derated equipment if required based on the site conditions. Derated equipment shall be provided with revised manufacturer's nameplates stating the equipment rating for continuous duty and the environmental conditions upon which the continuous rating applies. Deration of equipment shall only be allowed if the derated equipment rating conforms to the required equipment ratings as shown on the Contract Documents.
 4. Provide supplementary equipment deration if required for both ambient temperature extremes and elevation as required by the manufacturer.

1.07 ENCLOSURE TYPES

- A. Unless otherwise indicated in the Contract Documents, electrical enclosures, conduit systems, and electrical installations shall conform to the following ratings:
 1. NEMA 3R: outdoor locations and facilities

2. NEMA 4: outdoor locations, below grade structures, and indoor locations subject to non-corrosive, wet, or dirty conditions including but not limited to:
 - a. Outdoor facilities
 - b. Basements
 - c. Buried vaults
 - d. Below grade process facilities
 - e. Hose down areas
 - f. Non-corrosive process treatment basins, tanks, or vessels.
3. NEMA 4X: locations subject to corrosive or marine conditions including but not limited to:
 - a. Chemical feed or storage areas
 - b. Wastewater treatment areas
 - c. Wastewater or other corrosive process treatment areas (basins, tanks, or vessels)

1.08 UTILITY SERVICE AND METERING

A. Electrical Power Utility

1. The Electrical Utility serving this facility is Pacific Gas & Electric (PG&E). Utility contact information is as follows:

Peter Siu, Project Manager
275 Industrial Road
San Carlos, CA 94070
(650) 598-7241
PxSo@pge.com

2. The Utility Company will be providing the electrical service to the facility. The following equipment will be provided by the Utility Company:
 - a. Metering devices in meter enclosure.
 - b. Primary conductors from power source (pole or vault) to transformer.
 - c. Secondary conductors from transformer to point of service meter enclosure.
 - d. Pad mounted transformer.
 - e. Demolition or removal of the existing service equipment.
3. The Contractor shall provide the following for the facility:
 - a. Metering enclosure per Utility Standards.
 - b. Primary service conduits from power source (pole or vault) to transformer as shown on Drawing.
 - c. Secondary service conduits from transformer to point of service.
 - d. Transformer Pad per Utility Company standards.
 - e. Transformer grounding system in conformance with Utility Company standards.

4. Contractor shall provide all coordination with Utility Company and coordinate necessary shutdowns with the City.
 5. The Contractor shall coordinate and pay for all engineering, connection, and other fees associated with the new Utility Company work performed under this Contract.
- B. Telephone Service: The City will provide wireless telephone service for remote alarm notification. The City's wireless provider is Verizon Wireless.

1.09 HANDLING AND SIZE OF EQUIPMENT

- A. Investigate each route at the facility through which electrical equipment must pass to reach its final installed location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the facility and within structures.
- B. The equipment shall be kept upright at all times during storage and handling. Should the equipment require tilting for passage through restricted height areas, brace the equipment to insure that the tilting does not impair the structural or functional integrity of the equipment.

1.10 MAINTENANCE

- A. Spare Parts
 1. Spare parts shall be in accordance with Section 01782 and as defined in the related technical specification sections. All spare parts shall be new and unused, provided in original packaging.
 2. All spare parts shall be individually packaged and labeled with the part designation and the associated end use equipment tag designation as shown on the Contract Documents.
 3. Provide one pint of touch-up paint, in one-quart containers for each type and color used for all cabinets, panels, consoles, etc, supplied under the related specification sections.
 4. The spares listed above shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

1.11 RECORD DRAWINGS

- A. As the work progresses, clearly and legibly record all field changes on a set of project contract drawings, hereinafter called the "record drawings set". Record drawing set shall conform to the requirements of Section 01700.
- B. Record drawing set shall be kept at the job site and readily available for review by the City or the Engineer.
- C. Record drawings shall be updated daily by the Contractor to provide an accurate record of the current condition of the work.
- D. Record drawing set shall accurately show the installed condition of the completed project. The record drawing set shall accurately document the final locations and conditions of the following items:
 1. One-line Diagrams
 2. Raceways and pull boxes

3. Conductor sizes and conduit fills
4. Lighting and distribution panelboard Schedules
5. Control wiring diagrams
6. Lighting fixtures, receptacles, and switches
7. Underground electrical system raceway and duct bank routing shown on the plan drawings. Routing shall include final installation depths below finished grade. Final locations of handholes and manholes shall be documented using the project coordinate system.
8. Plan views of distribution transformers, motor control centers and panelboards; including dimensioned outline of final installed location of the equipment.
9. Grounding system including location of ground rods and routing of grounding electrode conductors and ground grid components.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer.
- B. Unless otherwise indicated, provide materials and equipment which are the standard products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturers' latest standard design that conforms to these Specifications.

2.02 SEISMIC REQUIREMENTS

- A. General: All products to be furnished under this contract shall be designed, constructed, and installed in conformance with the seismic requirements of Section **01612**.
- B. Provide equipment seismically certified for application at the Project site where specifically called for in other Sections of Division 16.

2.03 EQUIPMENT IDENTIFICATION

- A. Identify all equipment, disconnect switches, separately mounted motor starters, control stations, etc. furnished under Division 16 with the name of the equipment it serves unless otherwise noted. Motor control centers, control panels, panelboards, switchboards, switchgear, junction or terminal boxes, transfer switches, etc. shall have nameplate designations as shown on the Drawings.
- B. Nameplates shall be engraved, laminated plastic, not less than 1/16-in thick by 3/4-in by 2-1/2-in with 3/16-in high white letters on a black background.
- C. Edges of the nameplates shall be beveled and smooth. Nameplates with chipped or rough edges will not be acceptable.

2.04 MARKINGS AND EQUIPMENT WARNING SIGNS

- A. Provide arc flash warning labels on electrical power distribution equipment as specified herein.
- B. Provide high voltage warning labels and signage on electrical power distribution equipment in conformance with OSHA.

- C. Permanent warning labels shall be mounted at all mechanical equipment which may be started automatically or from remote locations. Labels shall be in accordance with OSHA regulations for personnel safety and shall be suitable for exterior use. The warning labels shall be self adhesive or fastened with stainless steel screws or bolts as required by the equipment mounting surface. Locate and mount labels as approved by the Engineer. Warning sign shall display the following:

CAUTION - THIS EQUIPMENT STARTS
AUTOMATICALLY BY REMOTE CONTROL

- D. Permanent warning labels shall be mounted at all electrical equipment enclosures where a voltage sourced from outside the enclosure is present. Labels shall be yellow colored Lamicaid or equal material, engraved with a minimum ¼" lettering mounted on the front exterior of the panel approximately 5' above finished floor or grade. The warning labels shall be self adhesive or fastened with stainless steel screws or bolts as required by the equipment mounting surface. Locate and mount labels as approved by the Engineer. Warning sign shall display the following:

CAUTION - FOREIGN VOLTAGES PRESENT

2.05 FASTENERS

- A. Fasteners and anchors for securing equipment to walls and floors shall be either hot dip galvanized after fabrication or stainless steel unless noted otherwise.

PART 3 - EXECUTION

3.01 GENERAL

- A. Unless specified otherwise, electrical equipment and anchoring systems shall be designed to withstand seismic forces as specified in Section 01190.
- B. Install materials and equipment in a workmanlike manner utilizing craftsmen skilled in the particular trade and conforming to standards of the industry. Provide work which has a neat and finished appearance. Carry out work in accordance with NECA Standard of Installation unless otherwise shown in the Contract Documents.
- C. Coordinate electrical work with the Engineer and work of other trades to avoid conflicts, errors, delays, and unnecessary interference with operation of the plant during construction.
- D. Check the approximate locations of light fixtures, electrical outlets, equipment, and other electrical system components shown on Drawings for conflicts with openings, structural members, and components of other systems and equipment having fixed locations. In the event of conflicts, notify the Engineer in writing. The Engineer's decision shall govern. Make modifications and changes required to correct conflicts.
- E. Follow manufacturers' installation instructions explicitly, unless otherwise indicated on the Contract Documents. Wherever any conflict arises between the manufacturers' instructions, codes and regulations, and these Contract Documents, follow Engineer's direction. Keep copy of manufacturers' installation instructions on the jobsite available for review at all times.

3.02 PROTECTION DURING CONSTRUCTION

- A. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturers' recommendations for storage. Protect all equipment from the effects of weather.

- B. Prior to installation, store items in clean, dry, indoor or other locations suitably protected from the elements. Energize all integral equipment space heaters with temporary power as required. Provide temporary heating devices, sufficient to prevent condensation, for all other electrical equipment that does not have space heaters.
- C. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction, ensure that adequate protection from these atmospheres is provided. Such protection methods shall be approved by the Engineer.
- D. Cap all conduit runs during construction with manufactured seals until installation of conductors is required. Keep openings in boxes or equipment closed during construction.

3.03 SERVICE CONTINUITY (NOT USED)

3.04 EQUIPMENT IDENTIFICATION

- A. Provide identification nameplates for all electrical and instrumentation equipment provided under this Contract. Provide nameplate designations as shown on the Drawings and as specified herein.
- B. Nameplates shall be screw mounted to NEMA 1 enclosures. Nameplates shall be bonded to all other enclosure types using an epoxy or similar permanent waterproof adhesive. Two sided foam adhesive tape is not acceptable. Where the equipment size does not have space for mounting a nameplate the nameplate shall be fastened to the equipment using stainless steel wire or jack chain or permanently fastened to an adjacent mounting surface as directed by the Engineer.

3.05 EQUIPMENT SUPPORTS

- A. Provide equipment supports for all equipment in accordance with the mounting and anchorage requirements of Section 01190 and per manufactures requirements.
- B. Installation of equipment shall not proceed until mounting and anchoring calculations have been submitted and approved.
- C. Free standing panels and enclosures shall be mounted on concrete pads having plan dimensions shown on the Drawings or larger if required by the mounting and anchorage calculations.

3.06 SLEEVES AND FORMS FOR OPENINGS

- A. Provide and place all sleeves for conduits penetrating floors, walls, partitions, etc. Locate all slots for electrical work and form before concrete is poured.
- B. Identify precise locations for stubbing-up and terminating concealed conduit prior to commencing conduit layout work. Obtain shop drawings and templates from equipment vendors or other subcontractors and properly locate the concealed conduit before the floor slab is poured.
- C. Where setting drawings are not available in time to avoid delay in scheduled floor slab pours, the Engineer may allow the installations of such conduit to be exposed. Requests for this deviation must be submitted in writing. No additional compensation for such change will be allowed.
- D. Seal all openings, sleeves, penetration and slots as specified in Section 16130.

3.07 CUTTING AND PATCHING

- A. Lay out work carefully in advance. Do not cut, drill, or notch any structural member or building surface without specific approval of 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.
- B. Following cutting and patching work, restore surfaces to original finished condition. Include all patching and painting of the surfaces to match original. Use skilled craftsmen of the trades involved.

3.08 LOAD BALANCE

- A. The Drawings and Specifications indicate circuiting to electrical loads and distribution equipment. Balance electrical load between phases as nearly as possible on lighting and distribution panelboards, etc. based on the load requirements of the actual equipment provided under this Contract.

3.09 CLEANUP AND PAINTING

- A. The Contractor shall be responsible for the removal and legal disposal of all debris and unused equipment which he introduces to the project site during the execution of the Contract.
- B. Painting shall be in accordance with Section 09960. Unpainted boxes, cabinets, and raceways mounted on walls that are painted or to be painted shall be painted the same color as the walls.
- C. Keep the premises free from accumulation of waste material or rubbish. Upon completion of work, remove all materials, scraps, and debris from premises and from interior and exterior of all devices and equipment.
- D. Touch up scratches, scrapes, or chips in interior and exterior surfaces of devices and equipment with finishes matching as nearly as possible the type, color, consistency, and type of surface of the original finish. If extensive damage is done to equipment paint surfaces, refinish the entire equipment in a manner that provides a finish equal to or better than the factory finish, that meets the requirements of the Specifications, and that is acceptable to the Engineer.
- E. The interior of all electrical equipment, including windings of dry type transformers, shall be vacuumed and wiped free of dust, metal filings, and other debris. Cleaning shall be done prior to energization and again immediately before final inspection. De-energization of any equipment that is required to allow panel cleaning shall be approved in writing by the Engineer.

3.10 SHORT CIRCUIT AND PROTECTIVE DEVICES COORDINATION STUDY

- A. Provide a complete short circuit study and protective device coordination study for the pump station power distribution system. The study shall include the following major components:
 - 1. Utility protective device.
 - 2. 480V switchboards and motor control centers.
 - 3. Other equipment as necessary to comply with the coordination and arc flash requirements as specified herein.
- B. Analytical Tools

1. All analyses in the study shall be performed using software specifically designed for electrical system analysis. Software shall be SKM, ETAP, EasyPower or equal. The final approved study database shall be provided to the Agency in the native format of the software used for the analysis.
 2. The database for the study to be performed under this Contract shall match nomenclature and identification approaches used on the Drawings.
- C. The study shall be in full compliance with applicable ANSI and IEEE Standards.
- D. The electrical analytical studies shall be performed by a registered professional electrical engineer in the state of California with a minimum of five years' experience in the performance of such studies. Engineer shall have attended standard training sessions on the analytical package specified for use on this Project.
- E. The firm performing the study shall be responsible for obtaining any and all data required to complete the study and determine recommended setpoints. Data to be obtained shall include available utility short circuit duty; utility protective device make, model, and setting; all new and existing equipment characteristics and ratings; feeder sizes and lengths; new and existing loads and motor characteristics; and all other input data necessary to complete the study per the requirements of this Section.
- F. The study shall include but shall not be limited to:
1. Electrical distribution single line diagram, including utility, generators, transformers, cables, motor control centers, VFDs, or other source and end use equipment. The diagram shall identify each bus, transformer, reactor, etc., by name and corresponding node number using the approved bus tagging scheme. The available fault currents, Thevenin impedance and X/R ratio for each node, shall be indicated on the diagram. The single line diagram shall include cable sizes, lengths, transformer voltage, and transformer kVA.
 2. Available three phase and ground fault asymmetrical and symmetrical fault currents at each piece of electrical equipment, bus, transformer, etc.
 3. Overall system impedance diagram. The diagram shall include the power company's impedance and X/R ratio, circuit element impedances (e.g. transformers, generators, motors, VFDs, feeders, distribution buses, etc.).
 4. The available fault current at each bus within the limits of the study shall be identified and listed.
 5. The momentary and interrupting rating of all elements of the distribution system shall be listed. The maximum available fault current available at each element shall be calculated.
 6. Determine the adequacy of the electrical protective devices to withstand the maximum available fault at the terminals of the equipment. Provide an equipment list, the equipment rating (both momentary and withstand), the maximum available fault rating and the adequacy of the equipment to withstand the fault. Equipment that does not have adequate ratings shall be identified immediately and brought to the attention of the Engineer.
 7. Provide a complete set of time-current coordination curves on log paper. Limit the number of protective devices shown on any drawing to a maximum of four. A single line diagram depicting the portion of the distribution system under study shall appear with the curve. The minimum size log paper to be submitted shall be 11.5-in by 18-in.

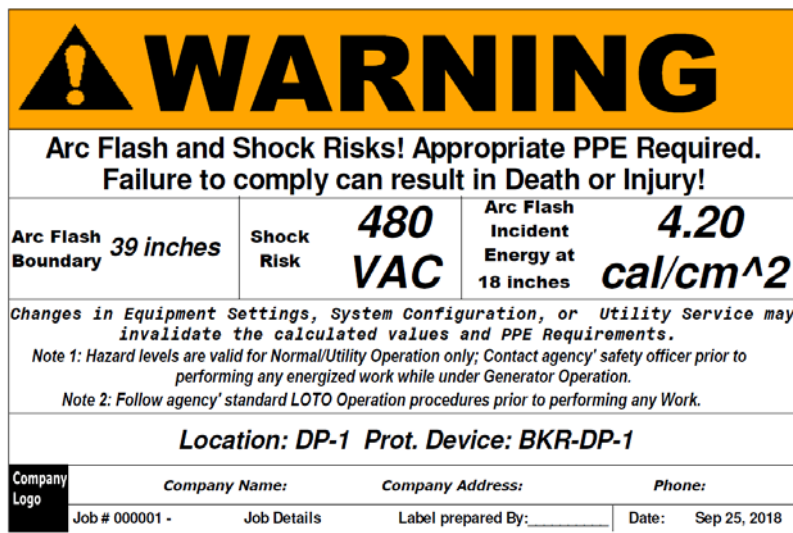
8. The time current plots shall include transformer ANSI damage and inrush points, cable damage curves, motor damage curves, capacitor damage curves, generator damage curves, circuit breaker and fuse ratings and settings, and any other information required by ANSI and good design practices. At a minimum provide curves for:
 - a. Utility protective device to service entrance main circuit breaker.
 - b. Each low voltage feeder down to 480 Volt main switchboard, motor control center, and variable frequency drives.
 - c. Each main and feeder circuit breakers located in the 480 Volt main switchboard and motor control center.
 - d. Each ground fault protective device provided for 480 Volt distribution systems and motor control center.
 - e. Motor starting profile for the largest motor connected to the main distribution point.
 - f. A tabulation of all the settings for every over current protective device, timer, power system relays (e.g. ANSI 25, 27, 32, etc), circuit breaker, recommended fuse and current transformer ratings, etc.
 - g. Motor, generator and cable damage curves in accordance with the manufacturer's recommendations.
 - h. A complete set of coordination curves for every circuit breaker, fuse, and relay serving or located in the electrical equipment furnished for the project including the utility protective devices.
 9. Provide recommended settings for all protective devices.
 10. Executive summary describing the distribution system, the procedures used to develop the study, utility related information furnished by the utility company including the name and telephone number of the individual supplying the information, identify all assumptions made in the preparation of the study, identified any problem areas and provide a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible fault current.
 11. Computer printout of the input data.
 12. Computer printouts for the three phase, single phase and ground fault studies. Printouts shall indicate the fault current available at each major equipment, distribution bus within the low voltage (480 Volt) distribution systems.
 13. Table listing all the electrical distribution and utilization equipment, the equipment interrupting and withstand ratings, the available fault current at the terminals of the equipment and the ability of the equipment to interrupt and/or withstand the fault.
- G. Provide a short circuit and system coordination report with the approved submitted equipment shop drawings. The report shall confirm equipment is being applied within design ratings and electrical protective devices will coordinate.
- H. The coordination study shall be submitted in PDF format or hardcopy bound in a standard 8-1/2-in by 11-in format, 3-hole punch binder. The selection of all protective relay types, current transformers, fuse types, and ratings shall be the

responsibility of the equipment manufacturer or system integrator and shall be based on the preliminary draft of the coordination study.

- I. The coordination study shall be stamped and signed by a Professional Electrical Engineer currently registered in California. The complete study shall be favorably reviewed by the Engineer before any equipment is shipped.

3.11 ARC FLASH HAZARD LABELS

- A. Produce Arc Flash Warning labels for all equipment operating at voltage levels above 50V to ground as recommended by the manufacturer of the equipment provided under Division 16. Provide permanent thermal transfer type, factory manufactured labels in conformance with NFPA 70E and ANSI Z535. Labels shall be made of high adhesion polyester and have electronic generated characters with no field markings. Labels shall be printed in color and indicate at a minimum, in addition to any other labeling requirements of NFPA 70E, the following:
 1. Nominal system voltage
 2. Arc flash boundary
 3. At least one of the following:
 - a. Available incident energy and the corresponding working distance, or the arc flash PPE category per NFPA 70E Tables 130.7(C)(15)(a) or Tables 130.7(C)(15)(b) for the equipment, but not both.
 - b. Minimum arc rating of clothing.
 - c. Site-specific level of PPE
- B. Submit the arc flash label design for approval. At a minimum, label shall contain details as shown in the Sample Arc flash label below.



3.12 TESTING AND COMMISSIONING

- A. General Requirements
 1. Test systems and equipment furnished under this section and repair or replace all defective work or equipment at no additional cost to the Owner. Adjust the

systems and instruct the Owner's personnel in the proper operation of the systems. Perform all tests and provide all meters, cable connections, instruments, equipment, and test apparatus necessary.

2. Testing and commissioning shall be performed in accordance with the latest revision of InterNational Electrical Testing Association (NETA) Standard ATS "Acceptance Testing Specifications" for Electrical Power Distribution Equipment and Systems.
3. Testing instruments shall be maintained in calibration per the requirements of NETA.
4. Test Reports:
 - a. A typed report shall be submitted after each testing step is completed. The report shall be submitted to the Engineer for review, comment and record purposes.
 - b. The report shall include a separate data sheet for each component (i.e. cable, circuit breaker, transformer, relay, etc.) tested. Each data sheet shall include the weather conditions at the time of the test (i.e. temperature, humidity, sunny, rain, etc), the tester's observation and findings, discrepancies, any remedial work performed or act to resolve problems, technical parameters obtained during the tests, as left settings of all devices, and a statement indicating the equipment is ready to be energized.
 - c. The report shall contain a statement indicating the equipment was tested in accordance with the procedures outlined in the latest edition of The International Testing Association Acceptance Testing Specifications.
5. Safety procedures as documented in CAL OSHA, NETA, and other applicable industry safety standards shall be adhered to.
6. Where ground fault protection is included on the main service disconnect, performance testing shall be provided. Testing shall occur on the installed ground fault protection equipment at the site. Testing shall be in accordance with the manufacturer's instructions of the provided equipment. A written record of this test shall be provided to the [City][District][Owner].

B. Field Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.
2. Selection of metering equipment should be based on the waveform of the variable being measured. Digital multimeters shall be RMS sensing type unless another type is required to accurately measure the variable under test.
3. Field test metering used to check power system meter calibration must have accuracy higher than that of the instrument being checked.
4. Accuracy of metering in test equipment shall be appropriate for the test being performed.
5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.
6. Test Instrument Standards
 - a. All equipment used for testing and calibration procedures shall exhibit the following characteristics:

- 1) Maintained in good visual and mechanical condition.
- 2) Maintained in safe operating condition.
- 3) Portable multimeters shall be true RMS measuring.
- 4) Test equipment should have operating accuracy equal to, or better than, the accuracy as recommended by NETA standards.

7. Test Instrument Calibration

- a. The Testing Firm shall have a calibration program which assures that all applicable test instruments are maintained within rated accuracy.
- b. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
- c. Instruments shall be calibrated in accordance with the following frequency schedule:
 - 1) Field instruments: 12 months maximum.
 - 2) Leased specialty equipment: 12 months.
 - 3) Dated calibration labels shall be visible on all test equipment.
 - 4) Records, which show date and results of instruments calibrated or tested, must be kept up-to-date.
 - 5) Up-to-date instrument calibration instructions and procedures shall be maintained for each test instrument.
 - 6) Calibrating standard shall be of higher accuracy than that of the instrument tested.

C. Field Testing and Commissioning Approach and Documentation

1. Testing shall be performed in four separate and totally independent steps
2. Test sequence summary: The following describes the testing steps to be performed:
 - a. Step No. 1 – Contractor’s Preliminary Test: Before the electrical equipment is energized, the Contractor shall test the equipment and set all protective relays, timers, etc., in accordance with the approved Short Circuit and Coordination Study and Arc Flash Hazard Study.
 - b. Step No. 2 – Manufacturer’s Field Tests (where required)
 - c. Step No. 3 – Commissioning testing
 - d. Step No. 4 – Utility Witness Testing
3. The Engineer shall be notified in writing immediately of any and all components that have unsatisfactory test results. The notification shall be accompanied with a proposed remedy, remedy schedule, and impact to the project schedule.

D. Field Testing and Commissioning Sequence

1. Step No. 1 – Contractor’s Preliminary Tests: Testing requirements to be performed by the Contractor before the equipment is energized:
 - a. Inspect and mechanically operate all air interrupter switches, circuit breakers, power disconnect switches, switches supplied on transformers,

and circuit breakers/disconnect switches installed within equipment furnished under other divisions of these specifications.

- b. Set, calibrate and test all protective devices including but not limited to, circuit breakers, protective relays, timing devices, motor overload, electrical protective devices located with equipment furnished under other Sections of these specifications.
 - c. Verify that protective relay, current transformers, ground sensing devices, transformer grounding resistors, fuses, interrupter switches, transfer switches, transformers and motor starters furnished are in accordance with the approved shop drawings and the Short Circuit and Coordination Study and Arc Flash Hazard Study.
 - d. Megger test all low voltage power system cables.
 - e. Test transformer insulating oil, check connections and proper torque and tightness of cables and bushings and perform high potential testing.
 - f. Verify that all power and control power fuses installed are in accordance with the manufacturer's approved shop drawings, the Short Circuit and Coordination Study and the NEC. Replace fuses found to be of the incorrect rating.
 - g. Verify control circuits and functionality of the controls for all motors, automatic transfer systems, remote protective device (i.e. wiring for differential protection relays, alarm systems, safety interlocks, emergency stop controls, and motor, transformer and generator protective devices). The functionality shall be in accordance with the approved control schematics, wiring diagrams or functional descriptions.
 - h. Check motor nameplates for correct phase and voltage; verify motor phase rotation.
 - i. Verify the resistance to ground of all power distribution equipment is 5 ohms or less.
 - j. Verify all terminations at the main switchboard and motors are correctly made and properly torqued.
 - k. Refer to the individual equipment and material specification sections for additional testing requirements.
 - l. Verify all circuit breaker ratings and settings are as required by the Contract Documents or as amended during shop drawing review. Advise the Engineer of discrepancies and make changes as directed by the Construction Manager.
 - m. Verify proper operation of accessories, devices and motor interlocks.
 - n. Submit comprehensive test report.
2. Step No. 2 – Manufacturer's Field Tests: Where required under this section.
 3. Step No. 3 – Employ the service of a third-party electrical power systems testing company (the Testing Firm) to perform a final acceptance test of the completed electrical systems. "Third Party" shall mean a testing firm that is not affiliated with the Contractor or Electrical Subcontractor.
 - a. The Testing Firm shall obtain the test reports for testing previously submitted along with the approved/corrected Short Circuit and Coordination

Study and Arc Flash Hazard Study and become familiar with the approach, conclusions, and recommendations. All potential discrepancies in the analytical studies shall be addressed by the Testing Firm before the testing begins.

- b. Test all new and modified equipment, components, controls, systems, and hardware provided under this Contract.
 - c. Testing shall follow the specific NETA ATS procedures, including "optional" items, for the equipment being tested.
 - d. Testing shall follow all NETA procedures for the particular equipment or systems being tested.
 - e. Standard NETA test forms or equivalent shall be utilized in conformance with the favorably reviewed test plan.
 - f. All visual and mechanical inspections and electrical tests shall be performed in accordance with the latest edition of the NETA requirements.
 - g. Perform inspections and testing for all the equipment in conformance with NETA guidelines including all inspections and testing requirements listed as "optional".
 - h. The NETA requirements for visual and mechanical inspections of equipment are considered the Contractor's responsibility under this Work. At the Contractor's discretion, however, the work may be included under this Section.
4. Step No. 4 - Perform additional witness testing of protective devices with utility representatives present per utility standards for confirmation of utility requirements prior to energization of new utility service. Utility witness testing shall be scheduled and coordinated by the Contractor with the utility and the construction schedule for the new service work. Testing shall follow procedures and guidelines for protective devices, relays, battery systems, and other equipment as documented in utility standard practices.

3.13 MANUFACTURER'S SERVICE AND TRAINING

- A. Provide manufacturer's services for equipment installation, startup, and testing. Provide training of plant personnel in operation and maintenance of the equipment furnished under other Sections of Division 16.

3.14 INSPECTION

- A. Allow materials, equipment, and workmanship to be inspected at any time by the Engineer and City or their representatives. Correct work, materials, or equipment not in accordance with these Contract Documents or found to be deficient or defective in a manner satisfactory to the Engineer.
- B. Before request for final inspection is made, the Contractor shall submit to the City, in writing, a certificate stating that the Contractor has made his own thorough inspection of the entire project and that the installation is completed and in conformance with the applicable codes, and the contract plans and specifications.

END OF SECTION

SECTION 16062
GROUNDING SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish all labor, materials, equipment and incidentals required and install a complete grounding system in strict accordance with Article 250 of the NEC, as shown on the Drawings and as specified herein.
2. All raceways, conduits and ducts shall contain equipment grounding conductors sized in accordance with the NEC. Minimum sizes shall be No. 12 AWG.
3. Provide grounding bus bars where shown on the Drawings.
4. Connect all hatches, metal stairs and handrails to system ground grid or system ground loop.

1.02 RELATED SECTIONS

- A. Section 16001 – Electrical - General Provisions.
- B. Section 16130 – Raceways, Boxes, Fittings, and Supports

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 and Section 16001.
- B. Submit product data for the following:
 1. Ground rods.
 2. Ground rod boxes.
 3. Exothermic welding materials and methods.
 4. Mechanical and compression type grounding clamps including installation requirements and materials.
 5. Grounding hubs and fittings.
- C. Submit results of grounding and bonding resistance testing as specified herein.
- D. Record drawings
 1. Submit as-built drawings showing locations of buried ground rods, grounding connections, location of embedded and buried ground conductors, ground test stations, and locations of stub-ups and pigtails for future connections to the grounding system.
 2. All drawings shall be dimensioned and include reference points, northing/easting coordinates, stationing, and other similar information necessary to locate buried and/or concealed grounding system infrastructure in the future.

1.04 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - 1. IEEE Std 142 – IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE Std 837 – IEEE Standard for Qualifying Permanent Connections used in Substation Grounding
 - 3. IEEE Std 100 – IEEE Recommended Practice for Power and Grounding Electronic Equipment
- B. American Society for Testing and Materials (ASTM).
 - 1. ASTM B 3 – Standard Specification for Soft or Annealed Copper Wire.
 - 2. ASTM B 187 – Standard Specification for Copper Bar, Bus Bar, Rod, and Shapes.
 - 3. ASTM B 8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- C. California Code of Regulations.
 - 1. Title 24, Part 3 – California Electrical Code (NEC), Article 250 (Grounding).
- D. Underwriters Laboratories (UL).
 - 1. UL 467 – UL Standard for Grounding and Bonding Equipment.
 - 2. UL 224 – UL Standard for Extruded Insulating Tubing.
- E. InterNational Electrical Testing Association (NETA).
 - 1. ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. All grounding and bonding products shall be UL listed.
- B. All exothermically welded or compression-type terminal lugs for buried or embedded connections shall use materials qualified in accordance with IEEE 837.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Direct-buried, concrete encased, and exposed grounding conductors.
 - 1. Bare concentric stranded copper conductors conforming to ASTM B-8 with Class B stranding, size as indicated on the Drawings.
 - 2. Acceptable manufactures:
 - a. Southwire
 - b. General Cable
 - c. Approved equal

- B. Ground rods
 - 1. 3/4 in by 8 ft copper clad steel constructed in accordance with UL 467. The copper thickness shall be 10 mil minimum, 15 mil average. Provide UL mark on ground rod.
 - 2. Acceptable manufacturers:
 - a. Eritech (Erico)
 - b. Harger
 - c. Approved equal
- C. Conduit grounding bushings
 - 1. Insulated, rated for 150° Celsius, malleable iron type with a solderless set-screw lug.
 - 2. Acceptable manufacturers:
 - a. Appleton
 - b. Hubbell Electrical Products (Raco)
 - c. Approved equal
- D. Waterpipe ground clamps
 - 1. Electroplated tinned bronze U-bolt style pipe clamp, sized as required for the pipe diameter and ground wire size specified.
 - 2. Acceptable manufacturers:
 - a. Harger
 - b. Blackburn (Thomas & Betts)
 - c. Approved equal
- E. Grounding system connections
 - 1. Buried, encased, or in areas where connections will be not be readily accessible after completion of construction.
 - a. Buried, encased, or otherwise inaccessible grounding connections shall be made with exothermic welds. Molds, cartridge materials, and accessories shall be as specifically recommended by the manufacturer of the molds for the types of items to be welded. Molds and powder shall be furnished by the same manufacturer.
 - b. Acceptable manufacturers:
 - 1) Erico (Cadweld)
 - 2) Harger (Ultraweld)
 - 3) Approved equal
 - 2. Accessible connections to equipment, connections to exposed structural steel (e.g. steel columns), connections to reinforcing steel, connections made to ground rods located in ground rod boxes, and all other locations where the connections are readily accessible to maintenance personnel after completion of construction.

- a. Mechanical connections to equipment, structural steel, and other accessible connections shall be made using one or two holes compression copper lugs as required for the cable size specified.
 - b. Mechanical connections to reinforcing steel shall be made using UL 467 listed irreversible crimp compression copper connectors with the “run” and “tap” sizes as required for the reinforcing steel and cable size, respectively, specified. Connectors shall be factory prefilled with moisture inhibiting compound.
 - c. Specific type of connectors shall be selected to match the specific connection to be made.
 - d. Acceptable manufacturers:
 - 1) Harger
 - 2) Blackburn (Thomas & Betts)
 - 3) Burndy
 - 4) Approved equal
- F. Pre-cast concrete boxes for ground-rod installation
- 1. Provide where shown on the Drawings. Provide boxes with cast iron riser rings, and traffic covers inscribed “GROUND ROD”. Provide H-20 traffic rated boxes and covers.
 - 2. Acceptable manufacturers:
 - a. Christy
 - b. Jensen Concrete Products
 - c. Approved equal
- G. Electrical joint inhibitor compound
- 1. Use at all bolted grounding connections as a moisture and oxidizing seal.
 - 2. Acceptable manufacturers:
 - a. Sanchem Inc., NO-OX-ID (A-Special Electrical Grade)
 - b. Approved equal

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prepare and clean piping, rods, and conductors prior to exothermic welding in conformance with the specific requirements of the welding system.
- B. Do not allow water pipe connections to be painted. If the connections are painted, disassemble them and remake them with new fittings.

3.02 INSTALLATION

- A. General
 - 1. Bond all exposed steel building columns in new structures together and connect to the grounding electrode system as shown on the Drawings. Connections to exposed structural steel columns or other exposed structural element shall be made with mechanical connectors.

2. Grounding of the pipe systems shall be provided per the requirements of NEC and as shown on the Drawings.
3. Metal conduits stubbed into power distribution equipment, control panels, or other enclosure shall be terminated with insulated grounding bushings and mechanically bonded to the enclosure's ground bus. Size the bonding wire in accordance with the NEC, except that a minimum No. 12 AWG shall be used.
4. Each separate building or structure shall have a grounding electrode or grounding electrode system per the requirements of the NEC.
5. All equipment enclosures, motor and transformer frames, conduits systems, cable armor, exposed structural steel and all other equipment and materials required by the NEC to be grounded, shall be grounded and mechanically bonded in accordance with the NEC.
6. Care shall be taken to ensure good ground continuity, in particular between the conduit system and equipment frames and enclosures. Where necessary, jumper wires shall be installed.
7. Liquid tight flexible metal conduit shall have bonding jumpers. Bonding jumpers shall be external, run parallel (not spiraled) and fastened with plastic tie wraps.
8. Run grounding electrode conductors in the building concrete slab/wall or as slab/wall-embedded unless otherwise shown on the Drawings.
9. Ground cable penetrations through building exterior walls shall enter within 3 feet below finish grade and shall be prepared with a water stop. Unless otherwise indicated, the water stop shall include filling the space between stands with solder and soldering a 12-inch copper disc over the cable.
10. Install equipment grounding conductors with all feeders and branch circuits. Each circuit shall have a dedicated equipment grounding conductor from source to load without splicing or "tee tapping" (e.g., three different receptacle circuits in a common home-run conduit back to a lighting panelboard shall have three separate equipment grounding conductors back to the lighting panelboard).
11. Ground metallic poles supporting outdoor lighting fixtures to a supplemental grounding electrode (rod) in addition to the separate equipment grounding conductor run with the supply branch circuit.
12. Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with ground clamp connectors.
13. Install driven ground rods in manholes and handholes close to wall and set rod depth at 4 to 6-inches above finished floor. Protect ground rods with double wrapping of pressure-sensitive tape or heat shrunk insulating sleeve from 2-in above to 6-in below concrete floor with connections of grounding conductors fully visible and accessible. Seal floor opening with waterproof, non-shrink grout. Where ground rods are installed outside of manhole or handhole, provide a No. 4/0 AWG bare copper conductor from ground rod into manhole or handhole through a waterproof sleeve in the wall. The ground rod shall be connected to the duct bank grounding electrode conductor where available.
14. Duct banks shall include a grounding electrode conductor where shown on the Drawings. Duct bank grounding electrode conductors shall connect to the facility grounding electrode system, including the grounding system of all manholes and handholes.

15. Direct-burial grounding grid electrode conductors shall be installed at a minimum depth of 24 inches below subgrade unless otherwise shown on the Drawings. Care shall be exercised at cable crossings to avoid damage to the cable. Damaged cable shall be replaced with new cable.

B. Ground connections

1. Electric Motors and Equipment
 - a. Grounding conductors for motors and equipment shall be connected by a solderless terminal and a 5/16-inch, minimum, bolt tapped to the motor frame or equipment housing.
 - b. Major equipment items shall have at least 2 ground-pad-type connections, and shall be attached to the main ground-grid at a minimum of 2 locations. Unless otherwise specified, connections of conductors to the equipment shall be with NEMA type, 2-hole, bolt-on bar lugs, and connections shall be made in accordance with the manufacturer's printed recommendations.
 - c. Paint, dirt, or other surface coverings shall be completely removed at the connection points of grounding conductors so that good metal-to-metal contact is made.
 - d. After grounding connections are made, areas around the connection point shall be prepared and the coating system repaired in accordance with Section 09960. Surfaces shall be restored to their original condition before the grounding connections are made.
 - e. Ground connections to smaller motors or equipment may be made by fastening the terminal to a connection box.
 - f. Junction boxes shall be connected to the equipment grounding system with 0.375-inch silicon-bronze machine screws.
2. Ground transformer neutrals, UPS neutrals, generators, and other separately derived sources to the nearest grounding electrode system as shown on the Drawings. The grounding electrode conductor shall be sized in accordance with the NEC unless otherwise specified on the Drawings. The grounding conductor shall be running continuous to the neutral (X/O) connection or run via an intermediate exposed bus bar located as shown on the Drawing or field located with the approval of the Engineer.
3. All grounding type receptacles shall be grounded to the outlet boxes with a No. 12 THWN/THHN/MTW green conductor connected to the ground terminal of the receptacle and fastened to the outlet box by means of a grounding screw.
4. The shielded power cables shall be grounded at the termination points as shown on the Drawings.
5. Ground instrumentation cable shields at a single point inside of the control panel at the signal grounding bus bar, unless grounding at the device is specifically required by the instrument manufacturer. Grounding of instrumentation shields shall conform to the requirements of Section 13410.
6. Grounding electrode conductors shall be exothermically welded to the foundation reinforcing steel grid as shown on the Drawings.
7. Seal exposed connections between different metals with electrical joint inhibitor compound. All buried connections shall be cleaned and coated with electrical joint inhibitor compound before backfilling.

8. Bolted connections shall not be buried or embedded. For compression-type connectors, the tool for crimping shall emboss the die index number into the connector as the crimp is completed. Each compression-type connector shall have an inspection port for use in checking proper conductor insertion. Compression connections shall be installed in strict accordance with manufacturer's printed recommendations using tools and dies of the proper size and type for the conductors, lug, and grounding electrode.
9. Molds used for exothermic welding shall be new. The number of welds made per mold shall not exceed the manufacturer's published recommendations.
10. Where pipe flange or piping is grounded by means of a clamp or lug, the pipeline coating shall be repaired, except the grounding connection area, as shown on the project Drawings or as specified under Section 09960 herein.
11. Intersections: Intersections of grounding cables shall be bonded together.
12. Taps and ground rods shall be connected by separate bonds to the main ground mat.

C. Ground rods

1. Install grounding electrodes at locations shown on the Drawings.
2. Drive ground rods to the depth shown on the Drawings. Interconnect ground rods and other grounding system components with the grounding conductor size shown on the Drawings.

D. Grounding Conductors

1. Unless otherwise specified, provide continuous, unspliced equipment grounding conductors.
2. Lay all underground grounding conductors slack within 10 feet from the footing and, where exposed to mechanical injury, protect by PVC schedule 40 conduit or other approved physical protection. If guards are steel pipe, or other magnetic material, electrically connect conductors to both ends of the guard. Make connections as specified in this Section.
3. Where grounding conductors extend beyond the perimeter of the building to site structures, the grounding electrode system shall be continuous and the grounding conductor shall be encased in concrete ductbanks. Provide a minimum 2 layers of Aqua Seal over the taped assembly.
4. Conductors to equipment enclosures/tanks shall be neatly run along the face of concrete footings or structural steel, following surfaces closely to the point of connection. Conductors shall be supported and secured with cable fasteners at intervals no greater than 5 feet.
5. Conductors shall be mechanically bonded to metallic enclosures at each end and to intermediate metallic enclosures such as pullboxes.
6. Grounding conductors shall be connected to grounding bushings on raceways.
7. Where equipment contains a ground bus, grounding conductors shall be extended and connected to that bus. The enclosure of the equipment containing the bus shall also be connected to the bus.
8. Expansion Fittings: To relieve shearing and pulling action at structural expansion joints, cables shall be run in expansion joint fittings as shown on the Drawings.

E. Fasteners

1. Clean the connector and conductor surfaces with a wire brush or emery cloth to a shiny, bright surface. For plated surfaces, compatible solvent cleaning shall be used in order not to remove any portion of the plating.
2. Immediately after cleaning, apply an oxide-inhibiting compound with suspended copper particles on the threads of the connectors, ground plate, bolts, and other hardware used for making mechanical grounded connections.
3. All fasteners shall engage a minimum of four full threads for electrical connections and equipment mounting.
4. All bolts shall be coated with electrical joint inhibitor compound.
5. Torque fasteners to manufacturer's requirements and NETA specifications.

3.03 INSPECTION AND TESTING

- A. Inspect the grounding and bonding system conductors and connections for tightness, proper installation, and proper application of electrical joint inhibitor compound.
- B. Testing shall be performed before energizing the distribution system.
- C. A separate grounding system test shall be conducted for each building or system.
- D. Notify the Engineer immediately if the resistance to ground for any building or system is greater than five ohms or if the resistance to ground for a substation is greater than one (1) ohm.

END OF SECTION

SECTION 16120

CONDUCTORS AND CABLES (600 VOLT MAXIMUM)

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work Included: This section covers furnishing and installing low voltage cable systems as specified herein, complete, and in operating condition.
- B. Raceway Schedules indicating conductor number and minimum required conductor sizes are shown on the Drawings. The Schedules are prepared as a guide to the Contractor and additional circuits from home runs, specialty manufacture red cables, and supplier specific wiring may require additional conductors not specifically included in the schedule. Such omissions in the Schedules shall not relieve the Contractor of the responsibility of furnishing and installing the necessary cables and raceways as required by the remainder of the Contract Documents for a fully functioning and operational system.

1.02 RELATED SECTIONS:

- A. Refer to Division 13 for additional system testing requirements and network and data highway cable requirements
- B. Section 16001 – Electrical - General Provisions
- C. Section 16442 – Motor Control Center

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 and Section 16001.
- B. Submit catalog data indicating manufacturer, insulation designation, and ratings in sufficient detail to determine conformance with these specifications:
 - 1. Power, control, and instrumentation wire.
 - 2. Termination and splicing materials.
 - 3. Pulling lubrication compound.
 - 4. Circuit identification system.
- C. Submit results of field testing for new conductors provided under this Contract and for existing conductors tested under this Contract as noted on the Drawings and as specified in Section 16001.

1.04 REFERENCES

- A. American Society for Testing and Materials (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.
 - 3. B-33 – Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
- B. International Cable Engineers Association (ICEA).
 - 1. S-95-658 – Non-Shielded Power Cable Rated 2000V or less

2. S-61-402 – Thermoplastic Insulated Wire and Cable for Transmission and Distribution
- C. National Fire Protection Association (NFPA):
1. NFPA 70 – National Electrical Code (NEC).
- D. National Electrical Manufacturers Association (NEMA):
1. NEMA WC 5, Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 2. NEMA WC 7, Cross-Linked- Thermosetting- Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
- E. Underwriters Laboratory (UL):
1. Standard 13 – Power Limited Circuit Cables
 2. Standard 44 – Thermoset Insulated Wires and Cables.
 3. Standard 83 – Thermoplastic Insulated Wires and Cables.
 4. Standard 444 – Communications Cables
 5. Standard 510 – Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
 6. Standard 1277 – Standard for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members
 7. Standard 1581 – Reference Standard for Electrical Wires, Cables and Flexible Cords.

1.05 CONDUCTOR COLOR CODING

- A. Color coding of multiconductor control and instrumentation cable is specified in the individual cable type specification.
- B. For power conductors, provide all single conductors and individual conductors of multiconductor power cables with integral insulation pigmentation of the designated colors, except conductors larger than No. 6 AWG may be provided with color coding by wrapping the conductor at each end and at all accessible locations with vinyl tape. Where this method of color coding is used, wrap at least six full overlapping turns of tape around the conductor covering an area 1 1/2 to 2 inches wide at a visible location at all conductor termination and pulling points.
- C. Phase A, B, C implies the direction of positive phase rotation.
- D. Mark conductors using the following colors for power conductors.

System	Conductor	Color
All Systems	Equipment Grounding	Green
208Y/120 Volts, 3-Phase, 4-Wire	Phase A Phase B Phase C Grounded Neutral	Black Red Blue White
480Y/277 Volts, 3-Phase, 4-Wire	Phase A Phase B Phase C Grounded Neutral (if used)	Brown Orange Yellow White, Black Tracer

- E. All conductors carrying AC foreign voltage over 100 Vac into control panels, switchboards, and other enclosures shall be yellow. Multi-conductor cables carrying such foreign voltage shall be marked with yellow tape at each termination point.

1.06 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall inspect the reels as they are unloaded from the delivery truck, any visible damage shall be reported by the Contractor and the reel returned to the factory.
- B. The Contractor shall provide a crane, special lift truck or forklift suitably rated to unload the cable reels.
- C. Cables shall be packaged on spools or reels. Each package shall contain only one continuous length of cable. The packaging shall be constructed so as to prevent damage to the cable during shipping and handling.

PART 2 - PRODUCTS

2.01 CONDUCTORS

A. General

1. All wire and cable conductors shall be annealed soft drawn copper with 98% conductivity. Aluminum conductors are not acceptable and shall not be used.
2. Provide Class B stranded conductors in all cases except that wiring for lighting and receptacle circuits may be solid.
3. Conductors shall be in accordance with applicable NEMA standards WC 3, NEMA WC 5, or NEMA WC 7. All conductors shall be UL Listed.
4. All conductors installed in tray shall be tray rated (Type TC) and run without splices in and out of the cable trays.
5. All conductors shall have ampacity ratings at 90° C in dry locations and 75° C in wet location minimum in accordance with the NEC unless noted otherwise.
6. Conductor sizes shown on the Drawings or schedules shall be the minimum size provided regardless of the type of conductor used.
7. Wire smaller than No. 12 AWG shall not be used for power feeders. Wire smaller than No. 12 AWG shall only be used for control, signal and instrumentation circuits,

- B. 600 Volt Single Conductor Power and Building Wire
 - 1. Provide type XHHW/XHHW-2 insulation for conductors No.12 and larger
 - 2. Where flexible cords and cables are specified, Type SO, 600-volt shall be provided, having the number and size of copper conductors shown on the drawings.
 - 3. Acceptable Manufactures:
 - a. Okonite, X-Olene
 - b. Southwire
 - c. General Cable
 - d. Approved equal
- C. 600 Volt Multi Conductor Control Cable
 - 1. General: Multi conductor control circuit interconnection cable with integral ground. Suitable for installation in open air, cable tray, conduit, wireway, direct buried or other approved raceways. Minimum cable temperature rating 90 degrees C dry and wet locations. Provide cable with size and number of conductors as shown on the Drawings or Schedules
 - 2. Individual Conductors: Class B stranded copper per ASTM B-8.
 - 3. Insulation and Jackets: Provide cross linked polyethylene insulated conductors UL listed per UL 1581 as Type XHHW-2. Outer PVC jacket shall be flame resistant, sunlight and oil resistant.
 - 4. Color code the conductor groups in accordance with ICEA S-61-402, Appendix K, Method 1, E 2.
 - 5. Acceptable Manufacturers:
 - a. Okonite – X-Olene
 - b. Southwire
 - c. General Cable
 - d. Approved equal
- D. 600 Volt, Twisted, Shielded Pair Instrumentation Cable:
 - 1. General: Type TC, single pair instrumentation cable designed for noise rejection for process control, computer, or data log applications. Suitable for installation in conduit, wireway, or other approved raceways. Minimum cable temperature rating shall be 90°C dry locations, 75°C wet locations.
 - 2. Individual Conductors: No. 16 AWG stranded bare annealed copper, Class B, 7 strand concentric per ASTM B-8, size as indicated on the drawings; 7 strand tinned copper drain wire.
 - 3. Insulation and Jacket: Each conductor 15 mil nominal PVC and 4 mil nylon insulation. Pair conductors pigmented black and red. Jacket flame retardant and sunlight and oil resistant PVC with 45 mil nominal thickness. Aluminum/polyester shield overlapped to provide 100 percent coverage.
 - 4. Acceptable Manufacturers:
 - a. Belden No. 9342

- b. Alpha Wire Company
 - c. Okonite
 - d. Approved equal
- E. Flexible Cords, Cables, and Fittings:
- 1. Where flexible cords and cables are required, provide Type SO, 600-volt, having the number and size of copper conductors shown on the Drawings.
 - 2. Provide liquid-tight strain relief fittings for exposed flexible cord and power cable where cables enter electrical panels and enclosures. Provide strain relief as manufactured by Hubbell (Kellums), OZ Gedney, or approved equal
- F. Electrical Tape for Color Coding:
- 1. Electrical tape shall be premium grade, not less than 7 mils thick, rated for 90 degree C minimum, flame-retardant, weather resistant, and available in suitable colors for color coding. The tape shall be resistant to abrasion, ultraviolet rays, moisture, alkalies, solvents, acids, and suitable for indoor and weather-protected outdoor use. The tape shall be suitable for use with PVC and polyethylene jacketed cables, and meet or exceed the requirements of UL 510.
 - 2. Acceptable Manufactures:
 - a. 3M 35 Scotch Vinyl Electrical Tape for Color Coding
 - b. Plymouth Rubber Company Premium 37 Color Coding Tape
 - c. Approved equal
- G. Low Voltage Splices, 600 volts and below:
- 1. Power Conductors
 - a. General: Provide low voltage splices consisting of 600 volt compression type connectors and connector insulators, suitable for indoor and outdoor field installations.
 - b. Provide two way, uninsulated, compression connectors, long barrel type, suitable for use with stranded copper conductors. Provide UL listed connectors rated 600 volts minimum. Acceptable manufacturers: Burndy, Thomas and Betts, Panduit, or approved equal.
 - c. Connector insulators shall be cold shrink type factory expanded and assembled tubular EPDM rubber sleeves, suitable for field installation. Insulators shall shrink over in line connections, forming a water proof seal. Provide insulators rated for 1000 volts, minimum.
 - d. Acceptable manufacturers:
 - 1) 3M Corporation
 - 2) Approved equal
 - 2. Control Conductors: Insulated compression type connectors shall be of the expanded vinyl insulated parallel or pigtail type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or approved equal.
 - 3. Solderless pressure connectors shall be self-contained, waterproof and corrosion-proof units incorporating prefilled silicone grease to block out moisture and air. Connectors shall be sized according to manufacturer's

recommendations. The connectors shall be UL listed and CSA approved, as manufactured by King Technology, St Louis, MO; Ideal Industries, Inc., Sycamore, IL or approved equal.

H. Low Voltage Terminations, 600 volts and below:

1. Power Conductors

- a. Provide solderless, die type or set screw compression type lugs and connectors. Provide plated copper alloy terminations as manufactured by Thomas and Betts; Burndy; or approved equal. Provide lugs and connectors recommended by the manufacturer for the cable type used.
- b. Motor connections shall be screw type insulated pressure connections terminations installed on the branch circuit wires and the motor leads and secured with bolt, nut and springwasher. Provide insulation by heat shrink boot especially made for motor termination use. Wire nuts, split bolts, etc., are not acceptable. Connections shall be insulated with a Raychem Type MCK, roll-on stub insulator or approved equal and shall be as recommended by the manufacturer for the cable type used.

2. Control, Status, and Alarm Conductors: Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or approved equal.

3. Instrumentation Cables: Termination connectors shall be of the locking fork-end (upturned leg ends) type as manufactured by Ideal Industries; 3M Co.; Panduit Corp. or approved equal.

I. Wire and Cable Markers

1. Wire and cable markers shall be pre-printed, clip sleeve type as manufactured by the W.H. Brady Co.; Thomas & Betts Co.; 3M Co. or approved equal.
2. Wire and cables with diameters exceeding the capacity of the clip sleeve type shall be marked with pre-printed, self-adhesive vinyl tapes as manufactured by the W.H. Brady Co.; Panduit Corp. or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Use lubrications to facilitate wire pulling. Lubricants shall be UL approved for use with the insulation specified.
- B. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. Pulling of cable shall be performed in such a manner that the cable outer jacket does not scrape against the edge of the conduit, at both the inlet and outlet ends of the conduit. Cable shall be free of sandy or gritty material during pulling. If cable is laid on ground during pulling, cable shall be wiped free of sandy or gritty material prior to entry of cable into conduit and prior to application of any pulling compound.
- C. Tighten all screws and terminal bolts using torque type wrenches and/or drivers to tighten to the inch pound requirements of the NEC and UL.
- D. Where single conductors and cables enter manholes, handholes, vaults, and other indicated locations bundle the conductors from each conduit throughout their exposed length with nylon, self locking, releasable, cable ties placed at intervals not exceeding 18 inches on centers.

- E. Wrap exposed lengths of 480V feeders in manholes or handholes, #4/0 and higher, with fire proof tape.
- F. Terminate no more than two control conductors per terminal point. Terminate all spare conductors on terminal blocks.
- G. When pulling low voltage power and control conductors in the same conduit, only combine conductors with no more than two wire sizes difference to prevent possible installation damage to the smaller conductors; otherwise use separate conduits.
- H. Uniquely identify all wires, cables and each conductor of multi-conductor cables (except lighting and receptacle wiring) at each end with approved wire and cable marker systems as specified under Section 16000.

3.02 CONDUCTOR 600 VOLTS AND BELOW

- A. Provide conductor sizes indicated on drawings with no splices except as approved in writing by the Engineer.
- B. Wire nuts may be used only on 120 volt lighting and 120 volt receptacle circuits. Place no more than one conductor in any single-barrel pressure connection. Use crimp connectors with tools by same manufacturer and/or UL listed for connectors of all stranded conductors. Soldered mechanical joints insulated with tape will not be acceptable.
- C. Color coding on wire sizes larger than No. 6 AWG shall be by taping the individual conductors with the appropriate colored self adhesive vinyl electrical tape.
- D. Provide terminals and connectors recommended by the manufacturer for the type of material used.
- E. Arrange wiring inside control panels, motor starters, switchgear. etc., neatly cut to proper length, remove surplus wire, and bridle and secure in an acceptable manner. Identify all circuits entering switchgear, motor starters, control panels, etc., in accordance with the cable schedules on the drawings. Terminate cable conductors on the same side of the terminal blocks as shown on the drawings.
- F. Terminations for power conductors shall be die type or set screw type pressure connectors as specified. Splices for power conductors if specifically requested by the Contractor and approved in writing by the Engineer, shall be die type compression connector and waterproof with shrink fit rubber boot (as specified) or epoxy filling for copper conductors # 4 AWG and larger. Splices shall be solderless pressure connectors with insulating covers for copper conductors # 6 AWG and smaller. Approved splicing shall be performed only in enclosures approved for splicing in the NEC.
- G. Terminate control and instrumentation wiring with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions. Where terminals provided will accept such lugs, terminate all control and instrumentation wiring (except solid thermocouple leads) with insulated, locking fork compression lugs. Control panel incoming field wireway sizes indicated on the Drawings are considered minimum. Contractor shall adjust wireway sizes to meet NEC percentage fill requirements.
- H. For terminals designed to accept only bare wire compression terminations use only stranded wire, and terminate only one wire per terminal. For control and instrumentation cables use ferrule on ends of wire. For cables terminating on terminal blocks, also use ferrule type. Tighten all terminal screws with torque screwdriver to recommended torque values.

- I. Attach compression lugs with a tool specifically designed for that purpose which provides a complete, controlled crimp where the tool will not release until the crimp is complete. Use of plier type crimpers is not acceptable.
- J. Where conductors pass through holes or over edges in sheet metal, remove all burrs, chamfer all edges, and install bushings and protective strips of insulating material to protect the conductors.
- K. For conductors that will be connected by Others, provide at least six feet spare conductor in freestanding panels and at least two feet spare in other assemblies. Provide sufficient spare conductor length in any particular assembly as required to reach the termination point plus an additional two feet of slack conductor.
- L. Cables passing through manholes and handholes shall be trained along the walls on cable racks. Allow two feet of slack in each run in a "drip loop" at least once along a wall. Loops and cables shall be organized, trained, bundled, and neatly installed.
- M. Do not strip cables more than eight inches from the nearest termination point of that cable.
- N. Cap spare conductors and conductors not terminated with UL listed end caps.
- O. All spare pairs shall be bundled and labeled with the cable designation. All individual pairs shall be tagged to enable identification of spare pairs when making future terminations.
- P. Splices will not be permitted except as accepted in writing by the Engineer.
- Q. Ends of cable shall not be exposed to the ambient environment more than 24 hours after pulling or splicing. After 24 hours the cable shall be purged with nitrogen or sealed with tape.

3.03 MULTI-CONDUCTOR POWER, CONTROL, AND INSTRUMENTATION CABLES

- A. All circuits shall be installed as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required.
- B. Terminal blocks shall be provided at all instrument cable junction and all circuits shall be identified at such junctions. Direct splicing of signal and instrumentation circuits is not acceptable. Shielded instrumentation wire, coaxial, data highway, I/O and fiber optic cables shall be run without splices between instruments, terminal boxes, or panels.
- C. Shields shall be grounded as recommended by the instrument manufacturer and isolated at all other locations. Terminal blocks shall be provided for inter-connecting shield drain wires at all junction boxes. Where individual circuit shielding is required, each shield circuit shall be provided with its own block.

3.04 LACING OF WIRES AND CABLES

- A. All wires and cables shall be laced in pull or junction boxes, manholes, handholes, wireways, and at each termination. Wires and cables shall be laced so that the wires of the individual circuits are laced together by circuit and the laced together circuit or cable shall be tagged with the cable number. All wiring entering and exiting the control panels shall be bundled into groups. Power, lighting, control, alarm, and instrumentation wiring shall be bundled and laced as specified herein.

3.05 FIELD QUALITY CONTROL

- A. Provide acceptance testing of all of the low voltage cables per Section 16080.

- B. Coordinate system loop checking including point to point cable continuity checking and verification in conformance with the requirements of Section 13300.
- C. All data highway and special systems cabling shall be tested as required by the system manufacturer requirements. Testing shall be performed as specified in the individual Division 13 or Division 16 sections to verify satisfactory signal transmission and reception in conformance with manufacturer's published requirements.

3.06 SPARES

- A. Identify spare conductors with source location and other identifiers as shown on the Drawings. Provide a minimum of 5-feet of extra conductors for each spare circuit. Wrap excess conductor lengths, provide with plastic tie-wrap, and coil up in last pullbox location of the run.

END OF SECTION

SECTION 16130

RACEWAYS, BOXES, FITTINGS, AND SUPPORTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. This section covers the work necessary to furnish and install, complete raceways and boxes for electrical systems.
2. Raceway Schedules indicating conductor number and minimum required conductor sizes are included in Appendix 16130-A. The Schedules are prepared as a guide to the Contractor and additional circuits from home runs, specialty manufacture red cables, and supplier specific wiring may require additional conductors not specifically included in the schedule. Such items not included in the Schedules shall not relieve the Contractor of the responsibility of furnishing and installing the necessary cables and raceways as required by the remainder of the Contract Documents for a fully functioning and operational system.
3. Home runs indicated are to assist the Contractor in identifying raceways to be installed concealed or exposed. Raceways identified to be installed exposed on the Drawings shall be run near the ceilings or along the walls of the areas through which they pass and shall be routed to avoid conflicts with HVAC ducts, cranes and hoists, lighting fixtures, doors and hatches. Raceways indicated to be run concealed shall be run in the center of concrete floor slabs, in partitions, or above hung ceilings, as required.

1.02 RELATED SECTIONS:

- A. Conduit Schedules are included under Appendix 16130-A
- B. Section 16001 – Electrical - General Provisions
- C. Section 16135 – Underground Raceway System

1.03 SUBMITTALS

- A. Submit data in accordance with Section 01300 and Section 16001.
- B. Submit manufacturers' names, product designation, and catalog numbers with marked cut sheets clearly and uniquely identifying all materials to be provided under this Section. Submit data for conduits, raceways, fittings, boxes, hardware, identification systems, and other materials specified in this Section.

1.04 REFERENCES

- A. American National Standards Institute (ANSI)
 1. ANSI C80.1: Electrical Rigid Steel Conduit (ERSC).
 2. ANSI C80.4: Fittings for Rigid Metal Conduit and Electrical Metal Tubing.
- B. California Code of Regulations
 1. Title 24, Part 3 – 2004 California Electrical Code (NEC)

- C. National Electrical Manufacturer's Associate (NEMA)
 - 1. NEMA FB 1: Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
 - 2. NEMA RN 1: Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - 3. NEMA TC2: Electrical Polyvinyl Chloride (PVC) Conduit
 - 4. NEMA TC3: Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
- D. Federal Specifications (FS)
 - 1. FS W-C-586D (A-A-50563): Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical: Cast Metal
 - 2. FS W-C-1094: Conduit and Conduit Fittings Plastic, Rigid
- E. Underwriters Laboratory (UL)
 - 1. UL 6: Electrical Rigid Metal Conduit - Steel
 - 2. UL 514B: Fittings for Conduit and Outlet Bodies
 - 3. UL 1660: Liquid-Tight Flexible Non-Metallic Conduit

1.05 CONDUIT SCHEDULES

- A. General: Conduit schedules are included in Appendix 16130-A.
- B. Identification: Conduits are identified on the Drawings using a tagging scheme as follows:

XX###A

where

XX: one or two letter designating function per the table below

###: conduit number including equipment number as required.

A: for parallel power feeder conduits, merged control conduits, parallel fiber optic conduits, or otherwise as required to ensure uniqueness

- C. Functional Designation Table

Conduit Designator Table

Letter Designator	Function
B	DC Battery
C	Control and Monitoring 120V
L	240/208/120V Panelboard Circuit
N	Other Network or Data Link
P	Power, <=480V
S	Low Voltage Signal (4-20mA)
U	Utility Service Conduits
X	Spare (e.g., PX### = spare power conduit)

PART 2 - PRODUCTS

2.01 STEEL CONDUIT AND FITTINGS

- A. Galvanized Rigid Steel Conduit (GRS)
 - 1. Hot-dipped galvanized rigid steel conduit, including threaded type couplings, elbows, nipples, and other fittings, shall meet the requirements of ANSI C80.1, ANSI C80.4, UL and the NEC. Do not use setscrew or threadless type couplings, bushings, elbows, nipples, and other fittings, except when approved in writing by the Engineer.
- B. Acceptable Manufacturers:
 - 1. Allied Tube and Conduit
 - 2. Western Tube & Conduit Corporation
 - 3. Cal Pipe Industries, Inc
 - 4. Approved equal

2.02 RIGID POLYVINYL CHLORIDE CONDUIT (PVC) AND FITTINGS

- A. PVC conduit shall be Schedule 40 [or 80], UL listed for concrete encased, underground direct burial, concealed, and direct-sunlight, weather-exposed use. Provide PVC conduit manufactured from virgin PVC compounds conforming to UL 651, listed and marked for use with 90° C insulated conductors.
- B. PVC conduits, couplings, elbows, nipples, and other fittings shall meet the requirements of NEMA TC 2 AND TC 3, Federal Specification W-C-1094, NEC Article 352, and ASTM D-1784 specified tests for the intended use.
- C. Provide conduits having a factory formed bell on one end. Conduit that requires the use of couplings for straight runs will not be acceptable.
- D. Acceptable Manufacturers:
 - 1. Carlon/Thomas and Betts (Lamson & Sessions) Plus 40 Rigid PVC Nonmetallic Conduit
 - 2. PW Eagle (PW Pipe)
 - 3. Allied Tube and Conduit (Tyco)
 - 4. Approved equal

2.03 PVC COATED RGS CONDUIT AND FITTINGS

- A. PVC-coated rigid steel conduit shall be hot-dipped galvanized rigid steel conduit meeting the requirements of NEMA RN 1, UL/6, and ANSI C80.1. Provide a factory installed PVC coating, 40 mils nominal thickness, and applied over and permanently bonded to the galvanized surface. Coating shall include an interior 2 mil urethane coating.
- B. All male threads on conduit, elbows, nipples and other fittings shall be protected by an application of a urethane coating; they shall be threaded and galvanized with integral plastic sleeves overlapping the plastic-coated conduit.
- C. Provide PVC coated conduit suitable for conductors with 75°C insulation.
- D. Product shall bear the ETL PVC-001 certification mark.

- E. Acceptable Manufacturers:
 - 1. Robroy, Plasti-Bond Red
 - 2. Thomas and Betts, "OCAL"
 - 3. Perma-Cote Industries, Supreme Conduit System
 - 4. Approved equal

2.04 FLEXIBLE METAL CONDUIT, LIQUID-TIGHT

- A. Flexible metal conduit shall be UL listed per UL 360, liquid-tight, consisting of galvanized steel flexible conduit core covered with an extruded PVC jacket and terminated with nylon bushings or bushings with steel or malleable iron body and insulated throat and sealing O-ring.
- B. Provide conduit with sunlight resistant outer jacket, suitable for both concealed and exposed location. Conduit shall be suitable for use in classified locations as defined by the NEC.
- C. Acceptable Manufacturers:
 - 1. Allied Tube & Conduit (Tyco), Liquid-Tuff
 - 2. Anamet, Anaconda Sealtite Type UA
 - 3. Electri-Flex Liguatite Type LA
 - 4. Approved equal

2.05 FLEXIBLE NON-METALLIC CONDUIT, LIQUID-TIGHT

- A. Non-metallic flexible conduit shall be seamless, liquid-tight UL 1660 listed, Type B conduit with rigid non-metallic reinforcing embedded in integral flexible PVC lining and jacket wall and shall be oil, acid, ozone and alkaline resistant, rated 105 degree C, 60 degree C wet, 70 degree C oil resistant.
- B. Non metallic conduit fittings shall be dusttight, liquid-tight, sunlight and chemical resistant, thermoplastic/nylon construction with tapered thread hub and integral neoprene O-ring gasket.
- C. Acceptable manufacturers:
 - 1. CARLON "CARFLEX"
 - 2. Allied Tube & Conduit (Tyco), Liquid-Tuff
 - 3. Hubbel/Kellems "PolyTuff I"
 - 4. Approved equal

2.06 MISCELLANEOUS RACEWAY FITTINGS

- A. Rigid Steel Fittings
 - 1. Watertight hubs for rigid steel conduit shall be male thread type zinc-plated malleable iron with recessed "O" ring seal.
 - a. Acceptable Manufacturers:
 - 1) OZ Gedney Type CHM
 - 2) Appleton HUB Series
 - 3) Myers Scru-Tite Hubs

- 4) Approved equal
 2. Provide insulated throat grounding bushings at each end of every metal conduit. Provide threaded zinc-plated malleable iron grounding bushings with solderless bonding screw and insulated throat rated for 150°C.
 - a. Acceptable Manufacturers:
 - 1) Thomas & Betts Grounding and Bonding Bushings
 - 2) OZ Gedney Type BLG
 - 3) Appleton Threaded Grounding Bushings
 - 4) Approved equal
 3. Provide all malleable iron conduit bodies and covers with captive stainless steel screws and neoprene gaskets.
 - a. Acceptable Manufacturers:
 - 1) Appleton Form 35 threaded Unilets
 - 2) Kilark
 - 3) Approved equal
 4. Conduit End Caps: Provide PVC end caps to plug spare conduits and protect against entry of rodents, water, or dirt into the spare conduit. Provide end caps designed to fit into the end of standard conduit trade sizes and include integral cap eyelet for tying off spare conduit pull ropes or string.
- B. PVC-Coated Rigid Steel Conduit Fittings:
1. General: All boxes and fittings used with PVC coated conduit shall be furnished with a PVC coating bonded to the metal, the same thickness as used on the coated steel conduit. The ends of couplings and fittings shall have a minimum of one pipe diameter PVC overlap to cover threads and provide a seal.
 2. Product shall bear the ETL PVC-001 certification mark where applicable.
 3. Provide insulated throat grounding bushings with threaded zinc-plated malleable iron grounding bushings with bonding screw and insulated throat rated for 150 degrees C.
 - a. Acceptable Products:
 - 1) Thomas & Betts Grounding and Bonding Bushings
 - 2) OZ Gedney Type BLG
 - 3) Appleton Threaded Grounding Bushings
 - 4) Approved equal
 4. Provide watertight and corrosion resistant hubs with a minimum 40 mil PVC exterior coating, a urethane interior coating, and pressure sealing sleeves.
 - a. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Type ST Hub
 - 2) Perma-Cote Industries Supreme Type ST Hub
 - 3) Approved equal

5. Provide corrosion resistant conduit bodies sized as required by the NEC. Provide cast iron conduit bodies and covers with captive stainless steel screws, a 40 mil minimum PVC exterior coating, 2 mil (nominal) internal urethane coating, and pressure sealing sleeves on all conduit openings.
 - a. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Conduit Bodies
 - 2) Perma-Cote Industries Supreme Conduit Bodies
 - 3) Approved equal
- C. Liquid-Tight Flexible Metal Conduit Fittings:
1. Throat Connectors:
 - a. In NEMA 4X areas, provide zinc-plated malleable iron or galvanized steel insulated throat connectors suitable for use in wet locations, with a minimum 40 mil PVC exterior coating and pressure sealing sleeves.
 - b. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Liquid Tight Connectors
 - 2) Perma-Cote Industries Supreme Liquidtight Connectors
 - 3) Approved equal
 2. Hubs:
 - a. In NEMA 4X areas, provide watertight and corrosion resistant hubs with a minimum 40 mil PVC exterior coating, a urethane interior coating, and pressure sealing sleeves.
 - b. Acceptable Manufacturers:
 - 1) Robroy Plasti-Bond Red Type ST Hub
 - 2) Perma-Cote Industries Supreme Type ST Hub
 - 3) Occidental Coating Company OCAL-Blue Double-Coat Type ST Hub
 - 4) Approved equal
 3. Conduit Bodies:
 - a. General: Provide conduit bodies sized as required by the NEC. Provide integral rollers and bushings to facilitate pulling and protect wire insulation for conduit bodies greater than 1-inch; provide mogul type conduit bodies for sizes greater than 2-inch.
 - b. For areas not designated NEMA 4X, provide cast iron conduit bodies and covers with captive stainless steel screws and neoprene gaskets.
 - c. Acceptable Manufacturers:
 - 1) Appleton Form 35 threaded Unilets
 - 2) Crouse-Hinds Form 7 threaded condulets
 - 3) OZ Gedney Form 7 threaded conduit bodies
 - 4) Approved equal

- d. For NEMA 4X areas, provide corrosion resistant conduit bodies sized as required by the NEC. Provide cast iron conduit bodies and covers with captive stainless steel screws, a 40 mil minimum PVC exterior coating and nominal 2 mil internal coating, and pressure sealing sleeves on all conduit openings.
- e. Acceptable products:
 - 1) Robroy Plasti-Bond Red Conduit Bodies
 - 2) Perma-Cote Industries Supreme Conduit Bodies
 - 3) Approved equal
4. Flexible couplings shall be type ECGJH as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electric Manufacturing Co. or equal.
5. Explosion proof fittings shall be as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; O.Z./Gedney Co. or equal.

2.07 BOXES

A. NEMA 4 Utility Boxes

1. Provide Type FD switch and outlet device boxes of cast or malleable iron or cast copper-free aluminum as required by the application. All device boxes shall be extra depth and gasketed. Covers shall be with cadmium-zinc finish with cast iron or aluminum covers and stainless steel screws.
2. Boxes shall be UL514 listed 514 conforming to NEMA FB-1 and Federal Specification W-C-586D standards.
3. Acceptable Manufacturers:
 - a. Hubbell-Killark
 - b. Appleton
 - c. Crouse-Hinds Co.
 - d. Approved equal

B. Provide NEMA 4 terminal boxes, junction boxes, pull boxes etc., manufactured of Type 316 stainless steel unless otherwise noted. Boxes shall have continuous welded seams and mounting feet. Welds shall be ground smooth. Boxes shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. Covers shall be continuously hinged, gasketed, and fastened with stainless steel clamps. Terminal boxes shall be furnished with terminal mounting straps and brackets.

1. Acceptable Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Lee Products Co.
 - c. Keystone/Rees, Inc.
 - d. Approved equal

C. Provide NEMA 4X terminal boxes, junction boxes, pull boxes, etc. manufactured of fiberglass reinforced plastic with stainless steel hardware unless otherwise noted. Covers shall be continuously hinged and gasketed. Terminal boxes shall be furnished with terminal mounting straps and brackets.

1. Acceptable Manufacturers:
 - a. Hoffman Engineering Co.
 - b. Lee Products Co.
 - c. Keystone/Rees, Inc.
 - d. Approved equal

2.08 WIREWAYS

- A. For all other areas or where NEMA 3R, NEMA 4, or NEMA 4X is shown on the Drawings, provide UL listed, raintight, hinged cover NEMA 4X wireway bodies and covers fabricated from stainless steel.

1. Acceptable Manufacturers:
 - a. Square D
 - b. Hoffman
 - c. Approved equal

2.09 RACEWAY SUPPORTS AND FITTINGS

- A. General: Raceways shall be supported using trapeze hangers, flush mounted hardware, conduit racks, and conduit hangers as shown on the Drawings and as required.
- B. For areas not designated as NEMA 4X on the Drawings, supports and fittings for support systems for electrical equipment and raceways shall be channel supports sized to meet specified seismic requirements. Finish shall be hot-dipped galvanized after fabrication for strut, pipe straps, clamp back spacers, hanger rod, strut nuts, u-bolts, beam clamps, and all other supports and fittings.

1. Acceptable Manufacturers:
 - a. Unistrut
 - b. B-Line
 - c. Power Strut
 - d. Approved equal

- C. For areas designated as NEMA 4X on the Drawings; supports and fittings for support systems for electrical equipment and raceways shall be channel supports sized to meet seismic requirements. Materials of construction shall be 40 mil PVC coated hot-dipped stainless steel, or self-extinguishing fiberglass which meets UL94V-0 flammability tests, for strut, pipe straps, clamp back spacers, hanger rod, strut nuts, U-bolts, beam clamps, and other supports and fittings. Support material used shall be resistant to the material resident in the location where installed.

1. Acceptable Manufacturers:
 - a. Robroy Plasti-Bond-Red PVC Coated Steel Strut and accessories
 - b. Fiberglass Strut and accessories
 - c. Perma-Cote Supreme PVC Coated Steel Channel and accessories
 - d. Approved equal

2.10 EXPANSION AND DEFLECTION COUPLINGS

- A. General: Provide expansion and/or deflection couplings for use where shown and wherever conduit crosses an expansion joint. The couplings shall alleviate longitudinal, angular, and shear conduit stress caused by thermal expansion and/or differential settlement.
- B. Couplings shall be suitable for either rigid metallic or non-metallic conduits and for embedded or exposed applications.
- C. Requirements:
 - 1. Suitable for wet locations, corrosion resistant
 - 2. Axial expansion or contracting up to 3/4 inch
 - 3. Angular misalignment of the axes of the coupled conduit runs in any direction up to 30 degrees
 - 4. Parallel misalignment of the axes of coupled conduit runs in any direction up to 3/4 inch
 - 5. Watertight flexible neoprene corrosion resistant outer jacket
 - 6. Integral flexible copper braid grounding straps to assure grounding continuity
 - 7. Stainless steel jacket clamps
 - 8. Integral Erickson union
 - 9. Couplings shall comply with UL standard 514B.
 - 10. Acceptable Manufacturers:
 - a. Crouse-Hinds Type XD
 - b. Appleton, Type DF
 - c. O.Z. Gedney Co. Type AXDX
 - d. Thomas and Betts, Type XD
 - e. Approved equal

2.11 CONDUIT TAGS

- A. Provide permanent, stamped brass round tags conduit numbers as designated on the conduit schedule, pressure stamped onto the tag. Stamped conduit identification numbers shall have a minimum height of 1/4-inches. Tags shall be fabricated from minimum 19 gauge brass with minimum diameter of 1-1/2-inches and predrilled mounting top hole.
- B. Tags relying on adhesives or taped-on markers are not acceptable. Attach tags to conduits with 316 stainless steel clamps at each end and at least once in every 50 feet near the midpoint of exposed conduit in ceiling spaces, surface mounted, and inside manholes and handholes.
- C. Conduits installed higher than 15 feet above finished grade or finished floor elevations shall be provided with large plastic identification nameplates at these locations. Minimum character size shall be 1/2" black engraved lettering on white plastic nameplate.
- D. Acceptable products
 - 1. Seton Identification Products

2. National Band and Tag Company
3. Emedco
4. Approved equal.

2.12 CONDUIT WALL PENETRATION SEALS AND SLEEVES

A. General

1. Conduit penetrations into buildings or structures shall be sealed to prevent infiltration of water into or out of the structure.
2. Provide modular, mechanical type conduit penetration seals consisting of fanged rubber type or interlocking synthetic rubber (EPDM) links shaped to continuously fill the annular space between the conduit and the opening or cast sleeve. The elastomeric element shall be sized and selected per the manufacturer's recommendations for the application shown on the Drawings. At a minimum, the seals shall be suitable for use in standard service applications (-40° F to 250° F) unless noted otherwise.
3. Sleeves shall be thermoplastic with water stops, suitable for poured wall construction.
4. Conduit penetration seals and sleeves shall be complete assemblies supplied by a single manufacturer.
5. Provide suitable seal for either conduit sleeve application or direct in core drilled wall penetration as required shown on the Contract Documents.
6. Acceptable products: O-Z Gedney Type CSM; Thunderline Corporation Link-Seal and Plastic Sleeves; Calpico Inc. Pipe Linx and Plastic Sleeves; or approved equal.

PART 3 - EXECUTION

3.01 GENERAL

- A. Protection during construction: Prior to installation, store all products in a dry location. Following installation, protect products from the effects of moisture, corrosion, and physical damage during construction. Keep openings in conduit and tubing capped with manufactured seals during construction. Cover PVC conduit, elbows, and PVC coated rigid steel conduit, nipples, elbows, and fittings from exposure to sunlight.
- B. Material and equipment installation: Follow manufacturer's installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between manufacturer's installation instructions, codes and regulations, and these contract documents, follow Engineer's decision. Keep copy of manufacturer's installation instructions on the jobsite available for review at all times.
- C. No wire shall be pulled until the conduit system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the conduit system has been completed in every detail.

3.02 INSTALLATION

- A. Minimum size conduit shall be 3/4-inch.

- B. Raceway type for location and installation method unless otherwise noted:
1. Exterior, exposed, higher than 6-inches above grade:
 - a. Galvanized rigid steel conduit
 2. Interior, exposed unless noted otherwise:
 - a. Galvanized rigid steel conduit
 3. Interior, concealed, not embedded in concrete:
 - a. Rigid steel conduit
 4. Embedded within or below structure concrete slabs or floors; installed within concrete or CMU walls:
 - a. PVC Schedule 40
 5. Risers through concrete pads:
 - a. PVC Coated rigid steel conduit.
 6. NEMA 4X areas:
 - a. PVC Coated rigid steel conduit.
 7. Exterior direct buried or concrete encased ductbanks
 - a. PVC Schedule 40
 8. PVC coated rigid galvanized steel elbows shall be used for pad-mounted transformer stub-ups.
 9. Conduits shall be installed using threaded fittings except for PVC.
 10. The use of running threads is prohibited. Where such threads are necessary, a 3-piece union shall be used. Rigid galvanized steel conduits which have been field cut and threaded shall be painted with cold galvanizing compounds.
 11. Flexible metallic conduit (Type MC cable) shall be used for recessed fluorescent fixtures in hung ceilings to connect fixtures to the conduit system.
 12. Rigid galvanized steel conduits buried in earth shall be completely painted with bitumastic.
 13. PVC coated rigid galvanized steel conduit shall be used for elbows at risers at the utility pole for electrical and telephone service conduits. Rigid galvanized steel conduit shall be used at utility pole for electrical and telephone service and fire alarm conduits to a height of 10-ft above finished grade. Furnish and install weather heads at service pole riser if required by utility company.
 14. Provide PVC coated rigid steel conduit under equipment mounting pads unless encased in concrete as specified herein.
 15. In exterior light pole foundations; extend PVC schedule 40 conduit 6 inches above the top of the foundation or as shown on the Drawings.
 16. Where conduit changes from underground direct burial to exposed; extend PVC coated rigid steel conduit up to 6 inches above finished grade or as shown on the Drawings.
 17. Where exterior conduit transition through concrete walls, slabs, and floors to exposed runs, provide PVC coated rigid steel conduit with factory manufactured

elbows. Extend PVC coated rigid steel conduit a minimum of 6-inches beyond the concrete walls, slabs, or floors or as shown on the Drawings.

C. PVC Coated Rigid Steel Conduit:

1. Suitable UL listed PVC coated conduits, boxes, and fittings only shall be used. Galvanized conduits with a subsequent or field application of PVC material is not acceptable.
2. Install in strict accordance with the manufacturer's instructions. Touch up any damage to the coating with conduit manufacturer acceptable patching compound. PVC boot shall cover all threads. Where belled conduits are used, bevel the unbelled end of the joint before joining. Leave no metallic threads uncovered. Clean field threads with solvent and coat with urethane touch-up. Keep two cans of urethane touch-up at each threading station.

D. Location, Routing, and Grouping:

1. Conceal or expose raceways as indicated on the Drawings. Group raceways in same area together. Locate raceways at least 12 inches away from parallel runs of heated piping for other utility systems.
2. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes to provide a neat appearance. Follow surface contours as much as possible. No diagonal runs will be allowed. All conduits shall be run plumb, straight, and true.
3. Run concealed raceways with the minimum of bends in the shortest practical distance considering the building construction and other systems.
4. In block walls, do not route raceways in the same horizontal course with reinforcing steel.
5. In outdoor, underground, or wet locations, use watertight couplings and connections in raceways. Install and equip boxes and fittings so as to prevent water from entering the raceway.
6. Do not notch or penetrate structural members for passage of raceways except with prior approval of the Engineer.
7. Do not run raceways horizontally in equipment foundation pads.
8. Separate raceway in slabs not less than three times the largest raceway outside diameter minimum, except at raceway crossings, and then only with the approval of the Engineer. Embed conduits in walls, floors, slabs, or overhead in the middle one-third of the concrete and at least 3-inches from the concrete surface; thicken slabs where necessary to accommodate conduits in a manner as approved by the Engineer.
9. Do not route raceways exposed across walkways unless approved conduit threshold coverings are provided.
10. Route conduits within the furring lines of building walls and ceilings unless specifically noted to be exposed.
11. Provide all necessary sleeves and chases required where conduits are routed through floors or walls; seal all openings and finish to match adjacent surfaces.
12. Where conduit routing changes from concrete embedded within floors, slabs, or equipment pads to exposed, maintain a minimum separation of 6-inches

between the closest wall, pad, or structure face and the outer edge of the exposed conduit.

13. Where conduits are routed through openings in walls or floor slabs, the remaining openings shall be sealed against the passage of flame and smoke in accordance with UL requirements and the details shown on the Drawings. The sealing method shall have a UL fire rating, which equals or exceeds the fire rating of the wall or floor construction.
14. Conduits shall not be routed to cause obstruction of passageways to pedestrian or vehicular traffic. Conduits shall not be routed across pipe shafts, access hatches or vent duct openings. They shall be routed to avoid such present or future openings in floor or ceiling construction.
15. Conduits routed from heated to unheated spaces, exterior spaces, refrigerated spaces, cold air plenums, etc, shall be sealed with "Duxseal" as manufactured by Manville or seal fitting to prevent the accumulation of condensation or shall be configured with conduit drain fittings and drip legs as shown on the Drawings.
16. Conduits shall be routed a minimum of 3-in from steam or hot water piping. Where crossings are unavoidable, the conduit shall be kept at least 1-in from the covering of the pipe crossed.
17. A mandrel shall be pulled through all existing conduits to be reused under this Contract and through all new conduits 2-in in diameter and larger. Conduits shall be proved with the mandrel prior to installation of any conductors.
18. Emergency (generator) source and normal (power company) source feeders shall not be run through the same pull box.

E. Box Applications

1. Unless otherwise specified herein or shown on the Drawings, all boxes shall be metal.
2. Pull boxes, junction boxes, or terminal boxes shall be used in any conduit run where a splice is required. Pull boxes shall be provided every 200 feet of straight run, every 150 feet with 90 degrees of bends, every 100 feet with 180 degrees of bends, and every 50 feet with 270 degrees of bends.
3. Where no type or size is indicated for junction boxes, pull boxes or terminal cabinets, they shall be sized in accordance with the requirements of the NEC. Enclosure type and material shall be as specified herein.
4. Exposed switch, receptacle and lighting outlet boxes and conduit fittings shall be cast or malleable iron, except that cast aluminum shall be used with aluminum conduit and non-metallic PVC shall be used with PVC.
5. Concealed switch, receptacle and lighting outlet boxes shall be pressed steel.
6. Terminal boxes, junction boxes and pull boxes shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16000.
7. Boxes flush in block, brick or tile walls shall be located at a course line and provided with square tile covers. Flush boxes shall not project beyond the finished surfaces nor shall surfaces project more than 1/8-in beyond the box enclosure. Wiring devices located in close proximity to each other shall be installed in one solid gang box with single cover.

8. All conduit bodies and pulling outlets shall comply with NEC wire bending space requirements. Mogul type fittings shall be used for sizes 2-1/2-in and larger. Where left or right side opening conduit bodies may be required for larger size conductors, provide pull boxes or other means where mogul style is not available. In no case shall the listed fill size cross sectional area for the conduit body be exceeded by the installed wire.
 9. Conduit terminating in pressed steel boxes shall have double locknuts and insulated bushings
 10. PVC conduit to non-metallic box connections shall be made with PVC socket to male thread terminal adapters with neoprene O-ring and PVC round edge bushings.
 11. PVC boxes, conduit fittings, etc, with integral hubs shall be solvent welded directly to the PVC conduit system.
 12. Non-metallic boxes with field drilled or punched holes shall be connected to the PVC conduit system with threaded and gasketed PVC Terminal Adapters.
- F. Final connection to equipment subject to movement or vibration:
1. Provide liquid-tight, PVC-jacketed flexible conduit for final connection to motors, wall or ceiling mounted fans and unit heaters, dry type transformers (primary and secondary terminations), generator terminations, valves, local instrumentation, and other equipment where flexible connection is required for vibration and to facilitate removal or adjustment of equipment.
 2. Provide 18-inch minimum, 60-inch maximum lengths unless otherwise approved by the Engineer. Provide flexible conduit size for installations of 4 inches or less. For larger sizes, use rigid steel conduit as specified.
 3. The flexible conduit length shall be sufficient to allow the connected equipment to be withdrawn and fully moved off its base.
 4. Non-metallic flexible conduit may be used for such connections when part of rigid PVC conduit systems.
 5. Flexible couplings shall be used in hazardous locations for all motor terminations and other equipment where vibration is present.
- G. Wireways: Mount wireways securely in accordance with the NEC and manufacturer's instructions. Orient cover on accessible vertical face of wireway to allow removal of all fasteners and complete removal or rotation of cover for installation of conductors.
- H. Raceway Supports
1. General: Support raceways at intervals not exceeding NEC requirements unless otherwise indicated. Supports shall be provided to ensure a rigid and durable installation.
 2. Single conduits shall be supported by means of one-hole pipe clamps in combination with one-screw back plates, to raise conduits from the surface.
 3. Multiple runs of conduits shall be supported on fabricated channel trapeze type racks with steel horizontal members and threaded hanger rods. The rods shall be not less than 3/8-in diameter. Surface mounted panel boxes, junction boxes, conduit, etc, shall be supported by spacers to provide a minimum of 1/2-in clearance between wall and equipment.

- a. Conduit support trapezes shall be vertically supported every 10-ft or less, as required to obtain rigid conduit construction.
 - b. Lateral restraints (sway bracing) shall be spaced 30-ft or less.
 - c. Horizontal restraints shall be spaced at 40-ft or less. There shall be at least one horizontal restraint per horizontal run.
 - d. Trapeze attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used when required for seismic restraints only.
4. Conduit Racks
- a. Support shall be spaced 10-ft or less, as required to obtain rigid conduit construction.
 - b. Horizontal seismic restraints shall be spaced at 30-ft or less.
5. Conduit Hangers
- a. Conduit hangers shall be vertical supported 10-ft or less.
 - b. Attachment to structural steel shall be by beam clamps or welded beam attachment. C-clamps will not be allowed for vertical hangers. Side beam clamps with beam hooks shall be used for seismic restraint only.
- I. Bends
1. Make changes in direction of runs with symmetrical bends or cast metal fittings. Make bends and offsets of the longest practical radius. Avoid field-made bends and offsets where possible, but where necessary, make with an acceptable hickey or conduit bending machine. Do not heat metal raceways to facilitate bending.
 2. Make bends in parallel or banked runs of raceways from the same center or centerline so that bends are parallel, concentric, and of neat appearance. Factory elbows may be used in parallel or banked raceways if there is a change in the plane of the run and the raceways are of the same size. Otherwise, make field bends in parallel runs.
 3. For PVC Schedule 40 conduits, use factory made elbows for all bends 30 degrees or larger. Use acceptable heating methods for forming smaller bends.
 4. Make no bends in flexible conduit that exceed allowable bending radius of the cable to be installed or that significantly restricts the conduits flexibility.
- J. Threaded Joints
1. Paint all field-cut threads with zinc rich paint or liquid galvanizing compound for rigid steel conduit and for PVC-coated rigid steel conduit after removal of chips and cleaning with solvent. Touch up after assembly to cover nicks or scars.
 2. Use approved, highly conductive jointing compound on all joints, Appleton Type TLC, or approved equal.
- K. Bushings, Hubs, and Insulating Sleeves:
1. Where rigid steel conduit, PVC coated rigid steel conduit, or liquid-tight flexible metal conduit enters metal cabinets/enclosures, install an insulated throat grounding bushing on the end of each conduit. Install a bonding jumper from

the bushing to suitable equipment ground bus or ground pad. Ground pads designated for instrumentation signal grounds as specified in Division 13 shall not be used for this purpose.

2. Interconnection or daisy-chaining of bonding jumpers from each conduit grounding bushing to the equipment ground bus or ground pad is acceptable.
3. If neither a ground bus or ground pad exists, connect the bonding jumper to the metallic enclosure with a listed bolted-lug connection.
4. All connections between conduits and NEMA 1, 1A, and 12 enclosures shall be made with hubs outside and bushings on the inside.
5. Conduit connections to NEMA 3R, NEMA 4, or NEMA 4X enclosures, junction boxes, terminal junction boxes, or device outlet boxes, shall be made with watertight, corrosion resistant hubs. The conduit connections shall maintain the integrity of the enclosure NEMA rating.

L. Raceway Penetrations:

1. Seal the interior of all raceways entering structures or buildings at the first box or outlet with duct seal to prevent the entrance into or exit from the structure of gases, liquids, or rodents.
2. All underground conduit penetrations at walls or other structures shall be sealed watertight using wall seals in core drilled openings or with specified conduit wall sleeves. Conduit wall seals and sleeves shall be used in accordance with the manufacturer's installation instructions and the details shown on the Drawings.
3. Above Grade Penetrations
 - a. Seal all above grade penetrations of concrete, CMU, metal, or wooden walls or roofs with duct seal. Install duct seal around conduit penetrations and inside conduits for sealing the annular space between conduit and conductors.
4. Liquid Chemical Containment Area Sealing: Internally and externally seal each conduit entering or leaving any liquid chemical containment areas to prevent chemical migration or drainage via the conduit system. Sealing shall be in accordance with the typical details shown on the Drawings. Seal conduits with a polyurethane elastomeric caulking material installed in accordance with the manufacturer's instructions. The material shall be SikaFlex-2C used with the primer No. 449 or No. 260 as appropriate for the conduit or approved equal.

M. Expansion Joints:

1. Provide expansion/deflection fittings for raceways crossing expansion joints in structures, between structures and walkways or concrete slabs to compensate for expansion, contraction, and deflection. Provide for the high rate of thermal expansion and contraction of PVC conduit by providing PVC expansion joints as recommended by the manufacturer and as required. See Structural Drawings for locations of expansion joints.
2. Provide expansion only fittings on exposed, rigid steel conduit runs a minimum of every 200 feet or as required for the specific thermal characteristics of the application.
3. Provide bonding jumpers around expansion joint fittings.

3.03 PREPARATION FOR PULLING IN CONDUCTORS

- A. Do not install crushed or deformed raceways. Do install conductors in cruised or deformed raceways.
- B. Install raceways to avoid introduction of traps.
- C. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them.
- D. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
- E. For concrete-encased raceways (after the concrete envelope has set), and for direct buried conduits, pull a bristle brush through each raceway to remove debris. Pull a mandrel of a diameter approximately 1/4 inch less than the raceway inside diameter, through each raceway.
- F. For all raceways which contain less than 50 percent of the NEC allowed fill of control cables or individual conductors, install a nylon pull rope with the conductors.

3.04 EMPTY RACEWAYS

- A. Certain raceways will have no conductors pulled in as part of this Contract. Identify with conduit tags at each end and at any intermediate pull point of each such empty, spare raceways.
- B. Raceways noted as spare shall be capped or plugged at both ends with easily removable conduit cap fittings
- C. Provide a fabricated, listed removable cap over each end of empty raceways. Provide cap with eyelet for tying off pull rope.
- D. 3/16-in polypropylene pull lines shall be installed in all new or existing unused conduits noted as spares or designated for future equipment. Provide a nylon pull rope with a minimum of 3-feet of slack length at each end of each empty raceway. Tie off the pull rope at the conduit end cap eyelet.

3.05 IDENTIFICATION

- A. Attach conduit identification tags to conduits with 304 stainless steel hose clamps and/or stainless steel jack chains.
- B. Provide conduit identification tags for all conduits at each end of conduit and at least once in every 50 feet of exposed conduit runs.
- C. Provide conduit identification tags for each conduit inside all manholes and handholes.
- D. Conduits installed higher than 15 feet above finished grade or finished floor elevations shall be provided with large plastic identification nameplates at these locations. Attach plastic nameplates with plastic ties.

3.06 PAINTING

- A. Paint exposed metal raceway systems in accordance with the requirements of Section 09900.

END OF SECTION

APPENDIX 16130-A

CONDUIT SCHEDULES

The Schedules are prepared as a guide to the Contractor and additional circuits from home runs, specialty manufactured cables, and supplier specific wiring may require additional conductors not specifically included in the schedule. Such items not included in the Schedules shall not relieve the Contractor of the responsibility of furnishing and installing the necessary cables and raceways as required by the remainder of the Contract Documents for a fully functioning and operational system

CONDUIT SCHEDULE					
Conduit Tag	Size [in.]	Fill	From	To	Comments
P010	5	PULL ROPE	PG&E XFMR	MSB-PD	
P011	5	PULL ROPE	PG&E XFMR	MSB-PD	
P020	5	(3)#500KCMIL, (1)#1/0-G	MSB-PD	MCC-PD	
X020	5	PULL ROPE	MSB-PD	MCC-PD	
P030	5	(3)#500KCMIL, (1)#1/0-G	MSB-PD	STANDBY GENERATOR	
P100	2	(3)#1/0, (6)#14-C, (1)#8-G	MCC-PD	WELL PUMP	6#14 spare
P200	1	(3)#12, (1)#12-G	MCC-PD	SOLUTION INJECTION PUMP	
P300	1	(3)#12, (1)#12-G	MCC-PD	AIR COMPRESSOR	
P400	1	(3)#12, (1)#12-G	MCC-PD	SHOWER WATER HEATER	
L030	3/4	(2)#12, (1)#12-G	LP-PD	GEN BATT CHARGER	
L031	3/4	(2)#12, (1)#12-G	LP-PD	GEN BLOCK HEATER	
L100	3/4	(2)#12, (1)#12-G	LP-PD	20-FIT-115	Well Pump Discharge Flowmeter
L200	3/4	(2)#12, (1)#12-G	LP-PD	J-BOX	TO CHLORINE CONTAINMENT AREA. L200A, L200B, L200C.
L200A	3/4	(2)#12, (1)#12-G	J-BOX	20-AIT-845/20-TIT-845	ph/Temp Analyzer
L200B	3/4	(2)#12, (1)#12-G	J-BOX	20-AIT-848	Total Chlorine Analyzer
L200C	3/4	(2)#12, (1)#12-G	J-BOX	20-AIT-825	Free Chlorine Analyzer
L201	3/4	(2)#12, (1)#12-G	LP-PD	20-P-810	FREE CHLORINE SAMPLE PUMP
L202	3/4	(2)#12, (1)#12-G	LP-PD	20-P-840	CHLORAMINE SAMPLE PUMP
L203	1	(3)#12, (3)#12-N, (1)#12-G	LP-PD	J-BOX	CHEM CONTAINMENT LIGHTS, RECEPTS & EYEWASH SHOWER LIGHT
L203A	3/4	(2)#12, (1)#12-G	J-BOX	CHEM CONTAINMENT LIGHTS	
L203B	3/4	(2)#12, (1)#12-G	J-BOX	CHEM CONTAINMENT RECEPTS	
L203C	3/4	(2)#12, (1)#12-G	J-BOX	EYEWASH SHOWER LIGHT	
L300	3/4	(2)#12, (1)#12-G	LP-PD	20-CP-200	Hydropneumatic Tank Panel
L500	3/4	(2)#12, (1)#12-G	LP-PD	20-CP-510	AMMONIA PUMP SKID

Conduit Tag	Size [in.]	Fill	From	To	Comments
L800	3/4	(2)#12, (1)#12-G	LP-PD	WELL PUMP PAD LIGHT	
L801	3/4	(2)#12, (1)#12-G	LP-PD	ENTRANCE LIGHT	
L802	3/4	(2)#12, (1)#12-G	LP-PD	HYDROP PAD LIGHT	
C030	3/4	(10)#14-C	20-CP-100	STANDBY GENERATOR	2#14 spare
C031	3/4	(2)#14-C	MSB-PD (ATS-PD)	STANDBY GENERATOR	
C200	1	(16)#14-C	20-CP-100	J-BOX	TO CHLORINE CONTAINMENT AREA. C200A & C200B.
C200A	3/4	(2)#14-C	J-BOX	20-LSH-410	Chlorine containment sump level probe
C200B	3/4	(14)#14-C	J-BOX	20-CP-410	CALCIUM HYPO SKID
C300	1	(8)#14-C	20-CP-100	20-CP-200	Hydropneumatic Tank Panel, 4#14 spare
C400	3/4	(2)#14-C	20-CP-100	20-FS-900	Eyewash Shower Flow Switch
C500	1	(12)#14	20-CP-100	J-BOX	AMMONIA CONTAINMENT AREA
C500A	1	(10)#14	J-BOX	20-CP-510	
C500B	3/4	(2)#14-C	J-BOX	20-LSH-510	Ammonia containment sump level probe
S030	1 1/4	(2)TSP-C	20-CP-100	STANDBY GENERATOR	spare
S100	1 1/4	(2)TSP-C	20-CP-100	J-BOX	
S100A	3/4	(1)TSP-C	J-BOX	20-FIT-115	Well Pump Discharge Flowmeter
S100B	3/4	(1)TSP-C	J-BOX	20-PIT-115	
S200	2	(8)TSP-C	20-CP-100	J-BOX	TO CHLORINE CONTAINMENT AREA. S200A, S200B, S200C, S200D
S200A	1 1/4	(2)TSP-C	J-BOX	20-AIT-845/20-TIT-845	ph/Temp Analyzer
S200B	3/4	(1)TSP-C	J-BOX	20-AIT-848	Total Chlorine Analyzer
S200C	3/4	(1)TSP-C	J-BOX	20-AIT-825	Free Chlorine Analyzer
S200D	1 1/4	(4)TSP-C	J-BOX	20-CP-410	CALCIUM HYPO SKID
S500	1 1/4	(3)TSP-C	20-CP-100	20-CP-510	AMMONIA PUMP SKID
X100	1	PULL ROPE	LP-PD	WELL PUMP PAD	STUB-UB CONDUIT & CAP
X200	1	PULL ROPE	LP-PD	CHLORINE CONTAINMENT AREA	STUB-UB CONDUIT & CAP
X300	1	PULL ROPE	LP-PD	HYDROP PAD	STUB-UB CONDUIT & CAP
X500	1	PULL ROPE	LP-PD	AMMONIA CONTAINMENT AREA	STUB-UB CONDUIT & CAP

SECTION 16135

UNDERGROUND RACEWAY SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish and install a complete underground system of raceways, manholes, handholes, fittings, and hardware as shown on the Drawings and as specified herein.
2. Where referred to in this Section, raceways are underground conduits and fittings; ductbanks are a collection of underground raceways; the underground electrical system is the collection of underground ductbanks, manholes, handholes, hardware, and other below and at grade structures as specified.
3. Install ductbanks, manholes, and handholes locations and depths coordinated with other utilities, yard piping, yard structures and field conditions per the Contract Documents. Underground electrical systems shall be installed to avoid interferences with other utilities, structures, and site features.
4. All underground electrical raceway systems shall be encased in steel reinforced concrete ductbanks unless specifically indicated otherwise on the Drawings. Ductbanks shall be steel reinforced, concrete encased, and structurally tied to buildings, vaults, manholes, handholes or other structures where shown on the Drawings and where specified.
5. Related Work: Underground electrical systems for electrical power, telephone, or other utility shall be in conformance with the requirements of the serving utility as applicable and per the requirements of Section 16001.

1.02 RELATED SECTIONS

- A. All trenching, drilling, backfill, compaction, and surface restoration shall be as indicated on the Drawings and as required under Division 2 of these Specifications. However, the responsibility of furnishing and installing the underground systems shall be included under this Section.
- B. All concrete and reinforcement shall be as indicated on the Drawings and as determined by structural design performed by Contractor. However, the responsibility of furnishing and installing the underground systems shall be included under this Section.
- C. Section 16001 – Electrical - General Provisions
- D. Section 16062 – Grounding System
- E. Section 16130 – Raceways, Boxes, Fittings and Supports

1.03 SUBMITTALS

- A. Submittals shall be made in accordance with Section 01300 and Section 16001.
- B. Concrete mix design for ductbank concrete encasement shall be submitted per the requirements of Division 3.
- C. Submit the following:

1. Raceway and conduit product catalog data indicating material, fittings, accessories, and sizes to be provided.
2. Handhole, splice boxes, and manhole catalog data including details of the structures and lids including material of construction, design loadings, knockout locations, internal and external dimensions, sump locations, and accessories.
3. Catalog data for underground raceway installation accessories including conduit spacers, cable racks, pull rope, pulling lubricants, sealants, identification warning tape, and other underground system components as specified herein.

1.04 REFERENCES

- A. Pacific Gas and Electric Company (PG&E), Electric & Gas Service Requirements (Green Book)
- B. American National Standards Institute
 1. ANSI C80.1: Electrical Rigid Steel Conduit (ERSC).
- C. American Society for Testing and Materials (ASTM)
 1. ASTM C857: Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 2. ASTM D1784: Standard Specification for Rigid Poly (Vinyl-Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl-Chloride) (CPVC) Compounds
 3. ASTM F512: Standard Specification for Smooth-Wall Poly (Vinyl-Chloride) (PVC) Conduit and Fittings for Underground Installation
- D. California Code of Regulations.
 1. Title 24, Part 3 – California Electrical Code (NEC)
- E. Federal Specifications (FS)
 1. FS W-C-1094: Conduit and Conduit Fittings Plastic, Rigid
- F. National Electrical Manufacturer's Associate (NEMA)
 1. NEMA RN1: Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 2. NEMA TC2: Electrical Polyvinyl Chloride (PVC) Conduit
 3. NEMA TC3: Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
 4. NEMA TC6 and 8: Polyvinyl chloride (PVC) Plastic Utilities Duct for Underground Installations
- G. The American Association of State Highway and Transportation Officials (AASHTO)
 1. AASHTO T 180: Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- H. Public Utilities Commission State of California
 1. General Order No.128, Rules for Construction of Electric Supply and Communication Systems.
- I. United States Department of Agriculture: Rural Utilities Service (RUS)

- J. Underwriters Laboratories (UL)
 - 1. UL 6: Electrical Rigid Metal Conduit - Steel
 - 2. UL 514B: Fittings for Conduit and Outlet Bodies
 - 3. UL 651A: Type EB and A Rigid PVC Conduit and HDPE Conduit
- K. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.05 QUALITY ASSURANCE

- A. Raceways, fittings, and other underground electrical system components shall be UL listed where such listings are available.
- B. The Contractor shall demonstrate to the Engineer that the approved manufacturer's recommended installation tools and methods are being utilized on the job site by all persons engaged in the installation of PVC coated rigid steel conduit, elbows, nipples, and fittings. These tools and methods shall include, but not be limited to, clamp inserts for use on power driven units of chain vises, new die heads and enlarged pipe guides in conduit threading machines, and strap wrenches and extra wide wrench jaws for use in conduit assembly. All tools and equipment used in the installation of PVC coated rigid steel raceways shall be in conformance with manufacturer's recommendations.

PART 2 - PRODUCTS

2.01 RACEWAYS AND FITTINGS

- A. Rigid Polyvinyl Chloride Conduit (PVC) and Fittings
 - 1. PVC conduit shall be Schedule 40, UL listed for concrete encased, underground direct burial, concealed, and direct-sunlight, weather-exposed use. Provide PVC conduit manufactured from virgin PVC compounds conforming to UL 651, listed and marked for use with 90° C insulated conductors.
 - 2. PVC conduits, couplings, elbows, nipples, and other fittings shall meet the requirements of NEMA TC 2 AND TC 3, Federal Specification W-C-1094, NEC Article 352, and ASTM D-1784 specified tests for the intended use.
 - 3. Provide conduits having a factory formed bell on one end. Conduit that requires the use of couplings for straight runs will not be acceptable.
 - 4. Provide factory elbows and large radius sweep bends with standard radii for all underground installations. Elbows and bends shall be by the same manufacture as the straight conduit and match PVC requirements as specified herein.
 - 5. Acceptable Manufacturers:
 - a. Carlon/Thomas and Betts (Lamson & Sessions) Plus 40 Rigid PVC Nonmetallic Conduit
 - b. PW Eagle (PW Pipe)
 - c. Allied Tube and Conduit (Tyco)
 - d. Approved equal

B. PVC Coated RGS Conduit:

1. PVC-coated rigid steel conduit shall be hot-dipped galvanized rigid steel conduit meeting the requirements of NEMA RN 1, UL/6, and ANSI C80.1. Provide a factory installed PVC coating, 40 mils nominal thickness, and applied over and permanently bonded to the galvanized surface. Coating shall include an interior 2 mil urethane coating.
2. All male threads on conduit, elbows, nipples and other fittings shall be protected by an application of a urethane coating; they shall be threaded and galvanized with integral plastic sleeves overlapping the plastic-coated conduit.
3. Provide PVC coated conduit suitable for conductors with 75°C insulation.
4. Product shall bear the ETL PVC-001 certification mark.
5. Acceptable Manufacturers:
 - a. Robroy, Plasti-Bond Red
 - b. Thomas and Betts, "OCAL"
 - c. Perma-Cote Industries, Supreme Conduit System
 - d. Approved equal

C. Connectors, Couplings, and Fittings

1. Connectors, couplings, fittings and ancillary materials shall be by the same manufacturer as the supplied conduit.
2. End Bells: Provide PVC bell ends to fit on conduit termination points. End bells shall be installed at all termination points for mitigation of potential damage to conductor insulation during wire pulling and installation. End bells shall be smoothly tapered without sharp or rough edges to minimize chance of insulation damage.
3. End Caps: Provide PVC end caps to plug spare conduits and protect against entry of rodents, water, or dirt into the spare conduit. Provide end caps designed to fit into the end of standard conduit trade sizes and include integral cap eyelet for tying off spare conduit pull ropes or string.

2.02 IDENTIFICATION WARNING TAPE

- A. Provide underground detectable warning tape. The tape shall be constructed of solid aluminum core that is laminated with a protective clear film on both sides, sealing and protecting the graphics from underground moisture, acids and alkalis. Tape color shall be red and be 6-inch minimum width, with black lettering, for use in trenches containing electric circuits. Use tape with printed warning "CAUTION-BURIED ELECTRIC LINE BELOW" or similar for single, telephone, fiber, network or other wiring systems.
- B. Warning tape shall be as manufactured by Seton Inc., Panduit Corporation or approved equal.

2.03 CONDUIT SPACERS

- A. Conduits installed in concrete encased ductbanks shall include spacers to provide uniform support and protection of conduits prior to concrete encasement or soil/sand backfill. The spacers shall be made of high density polyethylene and be of the interlocking module type.

- B. The spacers shall be arranged such that the centerline distance between the conduits is as shown on the Drawings
 - C. Spacers shall be manufactured by Carlon/Thomas and Betts (Lamson & Sessions); Underground Devices Inc.; Formex Manufacturing, or approved equal.
- 2.04 EXPANSION/DEFLECTION COUPLINGS
- A. Refer to Section 16130.
- 2.05 MANHOLES AND HANDHOLES
- A. Provide type and size of manhole/handhole per the Handhole and Manhole Schedule included in the Drawings. Minimum size handhole provided shall be 24" x 36" internal dimensions (nominal) unless otherwise noted.
 - B. Supports, pulling in irons, manhole steps and hardware shall be galvanized steel.
 - C. All handholes and manholes shall have solid bottoms with sump knockouts for drainage of water.
 - D. Provide extensions as required such that the depth of the handhole or manhole is coordinated with the depth of the ductbank and finished grade.
 - E. Metal covers and other exposed conductive surfaces within the manhole or handhole shall be bonded per NEC Article 250. Provide grounding strap between metal cover and metal frame or other metal surface in manhole or handhole for continuity of grounding system within the manhole or handhole. Ground rods where shown on the Drawings and other grounding materials and methods shall be as specified under Section 16062.
 - F. Manholes and handholes shall be precast concrete, heavy duty type, designed for a HS20-44 wheel load plus the weight of the soil above (using 120 pcf for the soil weight), impact loads, and hydrostatic loads in accordance with ASTM C857. Manhole and handhole covers shall include penta head type bolts to lock down covers.
 - G. Cover functional identification shall be included on every handhole and manhole cover. Identification shall be permanently engraved on the cover and shall indicate the handhole or manhole identification number as shown on the Drawings and the following as applicable:
 - 1. "Electrical" for 600V and below circuits
 - 2. "High Voltage" for medium and high voltage circuits
 - 3. "Communications" for all network systems including telephone and fiber optic cables
 - 4. "Signal" for instrumentation signals including 24VDC cables.
 - H. Precast units shall be as manufactured by Oldcastle Precast, Inc; Jensen Precast; or approved equal and constructed to dimensions as shown on the Drawings.
 - I. Conduit Identification: Provide conduit identification tags as specified in Section 16130.

PART 3 - EXECUTION

3.01 GENERAL

- A. Prior to trenching and installing underground conduits and/or underground ductbanks the Contractor shall verify field conditions and address all potential conflicts with other underground utilities, structures, or features.
- B. Protection during construction:
 - 1. Store all products in a clean, dry location prior to installation. Following installation, protect products from the effects of moisture, corrosion, and physical damage during construction. Keep openings in conduit and tubing capped with manufactured end caps during construction. Cover and protect PVC conduit, elbows, and PVC coated rigid steel conduit, nipples, elbows, and fittings from exposure to sunlight.

3.02 REQUIRED RACEWAY TYPE FOR LOCATION AND INSTALLATION METHOD

- A. Refer to Section 16130.

3.03 INSTALLATION REQUIREMENTS FOR UNDERGROUND RACEWAYS

- A. General:
 - 1. Trenching, shoring, backfill, compaction, and finished exterior surfaces shall conform with the requirements of Division 2.
 - 2. Coordinate installation of underground raceways with other outside and building construction work. Maintain existing outside utilities in operation unless otherwise authorized by the Engineer.
 - 3. Remove entirely and properly reinstall all raceway installations not in compliance with these requirements.
 - 4. Union type fittings shall not be used in underground installation.
 - 5. Provide a minimum cover of 24-inches over all underground direct buried raceways or top of concrete encasement envelope unless otherwise indicated on the Drawings.
 - 6. Concrete encasement and/or backfill of underground raceways shall not commence until inspected by the Engineer.
 - 7. Warning Tape: Bury warning tape approximately 12 inches below finished grade. Align parallel to and within 6 inches of the centerline of runs that are 2 feet wide or less. Provide two tapes and align parallel to and within 6 inches of the centerline of each side of runs that are more than 2 feet wide.
 - 8. Perform bends in raceways as follows:
 - a. Except at conduit risers, accomplish changes in direction of duct runs exceeding a total of 10 degrees, either vertical or horizontal, by long utility duct sweep bends having a minimum radius or curvature of 12-1/2 feet; utility duct sweep bends may be made up of one or more curved or straight sections or combinations thereof.
 - b. For direct buried conduit, accomplish changes in direction runs exceeding a total of 10 degrees, either vertical or horizontal by using 5 degree PVC-40 couplings.

- c. At conduit risers use manufactured bends having a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.
 9. Plug spare raceways and seal them watertight at all handholes, manholes, buildings and structures.
 10. Raceways installed under slab floors shall lie completely under the slab with no part of the horizontal run of the raceway embedded within the slab. Raceway shall be a minimum of 4" below the building or equipment slab.
 11. Install concealed, embedded, and buried raceways so that they emerge at right angles to and flush with the finished surface. None of the curved portion of the bend shall be exposed at the entry point.
 12. Raceway terminations at manholes shall include end bell connectors for PVC conduit and insulated throat grounding bushings for steel conduit.
 13. Patch all duct knockouts and openings in handholes with non-shrink grout.
- B. Separation and Support:
1. Separate runs of two or more parallel raceways in a single trench with preformed, nonmetallic spacers designed for the purpose. Install spacers at intervals not greater than that specified in the NEC for support of the type raceways used, and in no case greater than 5 feet.
 2. Support raceways installed in fill areas to prevent accidental bending until final concrete is set or backfilling/compaction is complete. Tie raceways to supports, and raceways and supports to the ground, so that raceways will not be displaced when concrete encasement or earth backfill is placed.
 3. When separate parallel duct banks are shown on the Drawings, provide a minimum horizontal separation between the parallel runs.
 - a. Power ductbank (over 100 Volts ground): Provide nominal 48-inch horizontal separation between adjacent duct bank sides or as much as allowable by the physical constraints of the site.
 - b. Signal ductbank (less than 100 Volts to ground): Provide nominal 24-inch horizontal separation between adjacent duct bank sides or as much as allowable by the physical constraints of the site.
 - c. Provide minimum 6-inch separation between signal ductbank and any power ductbank containing circuits energized above 150VAC to ground.
- C. Arrangement and Routing:
1. Arrange multiple conduit runs substantially in accordance with applicable details shown on the Drawings. Locate and route underground conduits as indicated on the Drawings.
 2. Make minor changes in location or cross section as necessary to avoid obstructions or conflicts. Where raceway runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, inform the Engineer for resolution before continuing with the work. Determine precise ductbank alignment and depth as required to avoid other utilities, structures, or features.
 3. Where piping systems are encountered by means of potholing or installed under this Contract along a ductbank route, maintain a 12-inch minimum vertical separation between raceways and other systems at crossings. Do not

place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the Engineer for instructions before continuing with the work.

4. Duct bank alignments shown on Drawings are diagrammatic. Actual alignments shall contain no sharp bends and shall be installed with long sweep bends. In no case shall minimum radius bends exceed values as defined in the NEC.
5. In multiple conduit runs, stagger raceway coupling locations so that couplings in adjacent raceways are not in the same transverse line.
6. Flare out incoming duct bank raceways at building walls or other structures sufficient to allow installation of conduit seals and sleeves with separation as recommended by the manufacturer. Coordinate core drill or conduit block-out locations for conduit entrances with the Structural Drawings.

D. Direct Earth Burial Conduit Zone Backfill Installation:

1. Backfill material for the conduit zone of direct burial conduit trenches may be selected from the excavated material if free from roots, foreign material, and oversized particles in conformance with Division 2.
2. Imported 3/4 inch minus gravel or sand may be used in lieu of material from the excavation.
3. Provide expansion couplings on each direct buried conduit within 10 feet of entry point into directly into building cable trench subsurface space.
4. After conduits have been properly installed, backfill the trench with specified material placed around the conduits and carefully tamped around and over them with hand tampers. Final, tamped conduit cover shall be 4-inches minimum prior to final backfill.

E. Backfill Installation above Conduit Zone of Direct Burial Conduit or above Concrete Envelope:

1. Backfill material above the conduit zone of direct burial conduit or above concrete envelope of concrete encased conduit may be selected from the excavated material if it contains no particles larger than 3 inches in diameter and is free from roots or debris in conformance with Division 2. Imported material meeting these same requirements may be used in lieu of material from the excavation. Compact backfill in maximum 12 inch layers to at least 95 percent of the maximum density at optimum moisture content as determined by AASHTO T 180 and as specified in Division 2.

3.04 INSTALLATION REQUIREMENTS FOR HANDHOLES AND MANHOLES

- A. Install handholes, manholes, and accessories as shown on the Drawings and per the manufacture's recommendations.
- B. Final ductbank, manhole, handhole, and other structure locations and depths vary based on installed depths and underground conditions. Set manholes, handholes, and other structures at the proper elevation such that the slope of raceways shall be towards manholes and handholes and away from structures, vaults and buildings.
- C. Provide synthetic rubber expansion joint material around duct bank envelopes at entry point to structures, handholes, or manholes. Fill gaps at expansion joint between duct bank and structure, handhole, or manhole with synthetic rubber sealing compound.

- D. For duct or conduit line connections to existing manholes, handholes or splice boxes, core drill or break the manhole, handhole, or splice box wall out to the dimensions required. Preserve the steel in the wall. Provide epoxy dowels into the existing concrete of the manhole, handhole, or splice box and backfill with concrete to achieve unitized construction.
- E. Unless shown otherwise on the Drawings, the handholes and manholes shall be laid on a minimum of 12" thick crushed rock base. Install structures flush with the final finished surface in paved areas and a nominal 3-inches above the final graded surface in non-paved or landscaped areas as shown on the Drawings. Install extension rings as necessary to establish the specified elevation of the handhole or manhole top with the finished grade.
- F. Install pulling-in irons anchored to the concrete and opposite all raceway entrances to handholes or manholes.
- G. Clean and remove any excess concrete, asphalt, dirt or other material to ensure that handhole and manhole tops, lids and hatches are flush to the surface, unobstructed, and can be fully open for access.
- H. Top identification lettering shall be clear and fully legible at the completion of the project.

3.05 PREPARATION FOR PULLING IN CONDUCTORS

- A. Do not install crushed or deformed raceways. Avoid traps in raceways. Take care to prevent the lodging of plaster, concrete, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Make raceways entirely free of obstructions or replace them. Ream all raceways, remove burrs, and clean raceway interior before introducing conductors or pull wires.
- B. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors.
- C. For all raceways which contain less than 50 percent of the NEC allowed fill of control cables or individual conductors, install a nylon pull rope with the conductors.
- D. Unless otherwise shown on the Drawings, install conductors in lower layers of conduits in manholes or handholes leaving upper layers of conduits as spares for future conductor installations.
- E. Installation of conductors shall conform to the requirements of Section 16120.

3.06 EMPTY RACEWAYS

- A. Certain raceways will have no conductors pulled in as part of this Contract. Identify with conduit tags at each end and at any intermediate pull point of each such empty raceway. Provide a fabricated, listed removable cap over each end of empty raceways. Provide a nylon pull rope with a minimum of 3-feet of slack at each end in each empty raceway. Provide cap with eyelet for attaching the nylon pull rope.

3.07 CABLE DUCT SHIELDS

- A. Provide shields where cables enter and leave manholes, handholes, and other entrances. Shields shall be of a suitable type manufactured for the purpose of protecting the cable from abrasion or other damage.

3.08 FIELD PAINTING

- A. Clean cast-iron frames and covers not buried in masonry or mortar of mortar, rust, grease, dirt, and other deleterious materials, and give a coat of bituminous paint.

Clean steel frames not buried in masonry and steel covers of mortar, dirt, and grease by an approved blasting process. Clean surfaces that cannot be cleaned satisfactorily by blasting process. Clean surfaces that cannot be cleaned satisfactorily by blasting by wire brushing or other mechanical means to bare metal. Wash surfaces contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly cleaned.

- B. Immediately after cleaning, coat surfaces with a pretreatment coating or give a crystalline phosphate coating.
- C. As soon as practicable after the pretreatment coating has dried, prime treated surfaces with a coat of zinc chromate primer and one coat of synthetic exterior gloss enamel as described in Division 9.
- D. Rigid galvanized steel conduits buried in earth or encased in concrete shall be completely painted with bitumastic based coating.

3.09 IDENTIFICATION

- A. Provide engraved conduit identification tags at each underground structure as specified in Section 16130.

3.10 RECONDITIONING OF SURFACES

- A. Restore paved and unpaved surfaces disturbed during the installation of duct or conduit to their original elevation and condition in accordance with Division 2.

END OF SECTION

SECTION 16141

WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish all labor, materials, and equipment and install wiring devices as shown on the Drawings and as specified herein.
2. Provide all interconnecting conduit and branch circuit wiring for receptacle circuits in accordance with the NEC.

1.02 RELATED SECTIONS:

- A. Section 16001 – Electrical - General Provisions
- B. Section 16130 – Raceways, Boxes, Fittings and Supports
- C. Section 16500 – Lighting System

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300.
- B. Submit annotated catalog cuts for all wiring devices provided under this contract. Annotation shall indicate the specific product type, rating, and application for each device provided.

1.04 REFERENCE STANDARDS

- A. Wiring devices shall comply with the requirements of the 2017 California Electrical Code (NEC).
- B. Federal Specifications (FS)
 1. FS WS 896: Switches, Toggle (Toggle and Lock), Flush Mounted General Specification
 2. FS WC 596: Connector, Electrical Power, General Specification For
- C. American National Standards Institute (ANSI)/National Electrical Manufacturer's Association (NEMA)
 1. ANSI/NEMA WD1: General Color Requirements for Wiring Devices
 2. ANSI/NEMA WD6: Wiring Devices/Dimensional Requirements
- D. American Society for Testing and Materials (ASTM)
 1. ASTM A193: Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
- E. Underwriters Laboratories (UL)
 1. UL 20: General Use Snap Switches
 2. UL 498: Attachment Plugs and Receptacles
 3. UL 514A: Metallic Outlet Boxes

4. UL 514C: Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
 5. UL 943: Ground-Fault Circuit-Interrupters
 6. UL 1449: Surge Protection Devices
- F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Wall Switches

1. Switches shall be heavy duty, industrial specification grade, toggle action, flush mounting quiet type with ground screw terminal. Provide switches in conformance with NEMA WD1, FS WS-896, and UL 20.
2. Provide 1-pole switches unless multi-pole switches are shown on the Drawings or if required to achieve the lighting control requirements indicated.
3. Toggle switch shall be ivory color.
4. Rating shall be 20A, 120/277 Volt with maintained contacts. Where shown on the Drawings provide momentary contact, 3-position, 2-circuit with center off style switches for application with lighting contactors as specified in Section 16500.
5. Provide switches with back and side wire terminals accepting up to #10 AWG stranded or solid conductors. Provide grounding screw terminal.
6. Acceptable manufacturers:
 - a. Cooper Wiring Devices, Inc. type E-1
 - b. Hubbell, Inc.
 - c. Approved equal

B. Duplex Receptacles – General Purpose Type

1. Duplex receptacles shall be, industrial specification grade, straight blade, 2 pole, 3 wire grounding type with contact made on two sides of the inserted blade. Provide in conformance with ANSI/NEMA WD1, FS WC 596, and UL 498. Provide isolated ground type where shown on the Drawings.
2. Rating shall be 20A, 125Volt.
3. High impact and chemical resistant nylon face. Provide corrosion resistant marine duty type where located in NEMA 3R, NEMA 4, or NEMA 4X locations as shown on the Drawings and in conformance with Section 16001. Provide face color ivory for standard applications; orange face for isolated ground applications; red face when powered from emergency or uninterruptible power sources.
4. NEMA configuration 5-20R per ANSI/NEMA WD6.
5. Acceptable manufactures:
 - a. Cooper Wiring Devices, Inc. type G-7; type G-9 for isolated ground applications; type M-1 for corrosion resistant, marine grade units.

- b. Hubbell, Inc.
 - c. Approved equal
- C. Duplex Receptacles - Ground Fault Circuit Interrupter (GFCI) Type
- 1. Provide GFCI type, industrial specification grade, 20 Amp, 125 Volt, 2 Pole, 3 Wire, feed thru type with "test" and "reset" buttons in conformance with UL 943. Units shall trip at 5mA.
 - 2. Provide corrosion resistant marine duty type where located in NEMA 3R, NEMA 4, or NEMA 4X locations as shown on the Drawings and in conformance with Section 16001.
 - 3. NEMA 5-20R configuration per ANSI/NEMA WD6. Units shall fit standard size boxes and be compatible with standard device plates.
 - 4. Acceptable Manufactures:
 - a. Cooper Wiring Devices, Inc. type GFCI
 - b. Hubbell, Inc.
 - c. Approved equal
- D. Duplex Receptacles – Surge Suppression Type
- 1. Provide transient voltage surge suppression (TVSS) type receptacles where shown on the Drawings. Provide 20A, 125Volt, 2 Pole, 3 Wire grounding type in NEMA 5-20R configuration, hospital grade conforming to UL 1449.
 - 2. Provide hot to neutral and hot to ground surge protection with clamping voltage of 400 Volts maximum and providing a minimum of 280 Joules of surge protection in each mode.
 - 3. Provide units having visual indication of the functionalities of the TVSS receptacle. Units shall have an audio alarm indication upon loss of ground or when surge protection is no longer functioning. Audio alarm shall include a front accessible alarm mute function.
 - 4. Acceptable manufacturers:
 - a. Cooper Wiring Devices, Inc. Type J1
 - b. Hubbell
 - c. Approved equal
- E. Device Plates
- 1. Plates for indoor flush mounted devices shall be of the required number of gangs for the application involved and shall be applied where shown on the Drawings and per Section 16001 as follows:
 - a. NEMA 1 (Finished) Areas: Smooth, high impact nylon of the same manufacturer and color (ivory) as the device.
 - b. NEMA 4X, 4, and 12 (Indoor Process) Areas: Stainless steel, brushed with stainless steel mounting screws.
 - 2. Plates for devices surface mounted outdoors shall be weatherproof.
 - a. Weatherproof receptacles shall have a gasketed weatherproof coverplate. Mounting screws shall be Type 304 stainless steel.

- b. Weatherproof switches shall have a gasketed, weatherproof, cast metal cover plate incorporating an external operator for the internal switch. Mounting screws shall be Type 304 stainless steel in accordance with ASTM A193.
3. Unless otherwise specified, plates for device boxes shall be of the same material as the box (metallic or non-metallic) per Section 16130.
4. Multiple surface mounted devices shall be ganged in a single, common box and provided with an adapter, if necessary, to allow mounting of single gang device plates on multigang cast boxes.
5. Engraved device plates shall be provided where required.
6. Plates shall be by the same manufacturer of the devices to which they are applied.
7. Weatherproof Protective Boot
 - a. Provide UL Listed weather protective boots over plug ends of cord connected equipment located in NEMA 3R, NEMA 4, and NEMA 4X locations. Industrial specification grade UL listed for wet locations with self closing spring door and gasketing.
8. Suitable for single and duplex receptacles
 - a. Cover manufactured by same manufacture of receptacle. Provide protective boots having neoprene covers and suitable for application on 120V, 3 Wire, 20 A devices. Provide protective boots as manufactured by Cooper Wiring Devices, Inc, type BS-1 or approved equal.
9. Weatherproof "Constant Use" Cover
 - a. UL listed single or two gang box cover made of polycarbonate, vertical arrangement.
 - b. Acceptable manufactures:
 - 1) Crouse-Hinds
 - 2) Approved equal

PART 3 - EXECUTION

3.01 INSTALLATION

- A. The locations of devices are shown diagrammatically on the Drawings and may be varied within reasonable limits so as to avoid piping, equipment, or other obstruction. Coordinate the final installation location of the devices with piping and equipment clearances and to conform to the requirements of the NEC. Any such relocation of wiring device locations shall be coordinated with the City and shall be performed at no addition to the Contract bid price.
- B. Devices shall be installed in conformance with manufacturer's recommendations. Manufacturer's recommended fittings and hardware shall be used in all cases.
- C. Faces of switches and receptacles shall be installed flush with the finished wall surfaces in NEMA 1 areas shown on the Drawings. Lighting switches shall be installed on the lock side of doors.
- D. Devices installed in areas designated NEMA 3R, 12, 4, or 4X on the Drawings shall be surface mounted.

- E. Provide weatherproof device covers for all wiring devices installed in areas designated NEMA 3R, NEMA 4, or NEMA 4X on the Drawings and per Section 16001.
- F. Provide “Constant Use” covers for receptacles used for cord connected mechanical equipment operated near water sources that are connected by means of a plug into a receptacle outlet such as sump pumps, sample pumps, analyzers, etc.
- G. Mount receptacles as follows unless noted otherwise on the drawings:
 - 1. 48-inches above the finished floor or grade.
- H. Device Plates
 - 1. Plates shall fit closely and tightly to the box on which they are installed.
 - 2. Plates on surface-mounted boxes shall not extend beyond the sides of the box unless the plates do not have sharp corners or edges.
 - 3. The plate material shall be compatible with the box material to prevent galvanic corrosion.
 - 4. Oversized plates shall be installed where standard plates do not fully cover the wall opening.
- I. GFCI Installation
 - 1. Use of feed-through circuiting may be used where ground-fault circuit protection is required for groups of receptacles. Feed through circuiting shall only be used for up to three receptacles maximum
 - 2. For applications with heat trace heating tape, provide GFCI protected breakers having adjustable sensitivity trip setting as specified per Section 16441. The use of GFCI receptacles for these applications is not acceptable.

END OF SECTION

SECTION 16145

MISCELLANEOUS ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

- A. All miscellaneous electrical equipment as shown on the Drawings and as specified in these Specifications.
- B. This Section provides the requirements for miscellaneous equipment typically employed in a facility; however, not all components specified in this Section are necessarily utilized on this Project.
- C. The following equipment is included under this Section:
 - 1. Manual motor starters.
 - 2. Control stations.
 - 3. Corrosion inhibitors.
 - 4. Equipment identification nameplates.
 - 5. Equipment mounting stands.

1.02 RELATED SECTIONS

- A. Section 16001 – Electrical - General Provisions
- B. Section 16062 – Grounding System
- C. Section 16230 – Standby Diesel Engine-Generator
- D. Section 16442 – Motor Control Center

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Section 01300 and the Standard and Special Provisions.
- B. Submittals shall contain detailed catalog information or drawings describing electrical and physical characteristics of all equipment specified.

1.04 REFERENCE STANDARDS

- A. Equipment enclosures shall have NEMA ratings suitable for the location in which they are installed, as specified in Section 16001.
- B. Underwriters Laboratories (UL):
 - 1. UL 1008 – Automatic Transfer Switches.
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 110 – Standard for Emergency and Standby Power Systems.
 - 2. NFPA 70 – National Electrical Code
- D. Institute of Electronic and Electrical Engineers:
 - 1. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems.
- E. National Electrical Manufacturers Association

1. NEMA – AC Automatic Transfer Switch Equipment.

PART 2 - PRODUCTS

2.01 MANUAL MOTOR STARTERS

- A. Manual starters shall be suitable for the voltage and number of phase shown on the Drawings and shall be non-reversing, reversing or two speed type as shown on the Drawings. NEMA sizes shall be as required for the horsepowers shown on the Drawings.
- B. Manual starters shall have motor overload protection in each phase when used as motor disconnect switches; overload protection is not required when used for device or instrumentation disconnects as specified under Section 13410.
- C. Provide one set of Form “C” auxiliary run contacts.
- D. NEMA 3R switch enclosures shall be factory painted steel, ANSI 61 gray
- E. NEMA 4 enclosures shall be 316 stainless steel.
- F. NEMA 4X enclosures shall be high impact strength fiberglass reinforced polyester.
- G. Manual motor starters shall be as manufactured by the Eaton Corporation; Square D Co.; General Electric; or equal.

2.02 CONTROL STATIONS

- A. Control stations shall be heavy-duty or industrial-duty type, sized to accommodate full size operators (30mm) as specified under Section 13420.
- B. Control station operators noted for use as local emergency stop (LES) on the Drawings shall be maintained contact, push to stop/pull to release type.
- C. Provide control stations sized for the number and type of pilot devices as shown on the Drawings. Control station dimensions shall be adequate to accommodate device contact blocks and a minimum of one additional auxiliary contact block for remote monitoring of pilot operator positions.
- D. Provide permanent engraved escutcheon plates for all devices labeled with the specific functions as shown on the Drawings or as specified (e.g., RUN, HAND-OFF-AUTO)
- E. NEMA 3R switch enclosures shall be factory painted steel, ANSI 61 gray
- F. NEMA 4 enclosures shall be 316 stainless steel.
- G. NEMA 4X enclosures shall be high impact strength fiberglass reinforced polyester.
- H. Control stations shall be by General Electric Co.; Eaton Corporation; Square D; or equal.

2.03 CORROSION INHIBITORS

- A. All equipment enclosures, terminal boxes, etc, located in a corrosive rated area (where shown on the Drawings) that contains electrical or electronic equipment or terminal strips shall be furnished with an internally mounted, chemically treated corrosion inhibitor pad.
- B. The corrosion inhibitor pads shall be as manufactured by Hoffman Engineering Co.; 3M or equal.

2.04 EQUIPMENT IDENTIFICATION NAMEPLATES

- A. All field mounted electrical equipment such as disconnects, push button stations, etc, shall be provided with a weather resistant engraved Laminoid equipment identification nameplate screwed or bolted adjacent to the device. Nameplate shall identify the mechanical equipment controlled exactly as shown on the electrical single line drawings (i.e., P-100 Well Pump).

2.05 EQUIPMENT MOUNTING STANDS

- A. Equipment mounting stands shall be custom fabricated from steel plate and steel supports, as shown on the Drawings.
- B. Steel plates and supports shall be hot dip galvanized after fabrication.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Mounting Stands
 - 1. Field mounted disconnects, pushbutton control stations, etc, shall be mounted on steel stands as shown on the Drawings. Where clearance requirements for stands may not be maintained, the Construction Manager may direct equipment to be wall-mounted adjacent to the equipment, but in no case shall the distance from the equipment to the control station exceed 3-ft.

END OF SECTION

SECTION 16222

LOW VOLTAGE MOTORS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide three-phase and single-phase AC induction motors 600V or less, rated 500HP or less and operating at greater than 75% load for equipment as shown on the Contract Documents.
- B. Provide all motor accessories, features, and enclosures as specified herein.
- C. Motors furnished under other Sections, shall be in conformance with the requirements listed in this Section unless otherwise noted in the detailed technical specifications included in Division 11 and 15.

1.02 RELATED SECTIONS

- A. Section 16001 – Electrical - General Provisions
- B. Section 16062 – Grounding System
- C. Section 16442 – Motor Control Center

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Sections 01300 and 16001.
- B. Submittal of motor data shall include complete nameplate data and test characteristics in accordance with NEMA Standard MG1 Part 12 and, in addition, the following for motors typical of the units furnished:
 - 1. Efficiency at 1/2, 3/4 and full load
 - 2. Power factor at 1/2, 3/4 and full load
 - 3. Motor outline, dimensions and weight
 - 4. Descriptive bulletins, including full description of insulation system
 - 5. Bearing design data
 - 6. Special features (i.e., space heaters, temperature detectors, etc.)
 - 7. Power factor correction capacitor rating, type, and mounting method
 - 8. Dimensional drawings for each item of couplings and motor to be furnished for motors to be replaced under this Contract
- C. For inverter duty rated motors, provide certification that the motor is in compliance with NEMA MG-1, Part 31.

1.04 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. IEEE 43: IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery
 - 2. IEEE 841: IEEE Standard for Petroleum and Chemical Industry – Severe Duty Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – Up To and Including 370 KW (500 HP).

3. IEEE 112: Standard Test Procedure for Polyphase Induction Motors and Generators.
 4. IEEE 114: Standard Test Procedures for Single-Phase Induction Motors.
- B. National Electrical Manufacturers Association (NEMA):
1. NEMA MG1: Motors and Generators
- C. American Bearing Manufacturers Association (ABMA)
1. ABMA 20: Radial Bearings of Ball, Cylindrical Roller, and Spherical Roller Types – Metric Design

1.05 QUALITY ASSURANCE

- A. Where motors are specified under the technical specifications as “Severe Duty” they shall be designed and manufactured in accordance with the latest version of IEEE Standard 841.
- B. Unless noted otherwise herein, routine tests shall be performed on representative motors in accordance with IEEE Standard 112, and shall include the information described in NEMA MG1-Part 12 and manufacture’s standard testing. Efficiency shall be determined in accordance with IEEE Publication No. 112, Method B. Power factor shall be measured on representative motors. Certification shall be provided that motors have passed the factory tests.
- C. Where motors are specified as “Critical” or otherwise called for under the process equipment technical specifications the manufacturer shall provide complete manufacturer’s testing on the specific motors provided under this Contract. Test results of representative motors from a manufactured group of motors shall not be acceptable. Submit specific test reports for the specific motors including the motor serial number on certified test forms. The complete test shall be done per the requirements of the manufacture’s standard factory test.

PART 2 - PRODUCTS

2.01 RATING

- A. Each motor shall develop ample torque for its required service throughout its acceleration range at a voltage 10 percent below nameplate rating. Where shown on the Drawings to be operated on a reduced voltage starter, the motor shall develop ample torque under the conditions imposed by the reduced voltage starting method.
- B. All motors shall be rated for continuous duty suitable for operation in a 40 degrees C ambient and not less than minus 15 degrees C with altitudes less than 1,000 meters unless otherwise noted.
- C. Motors shall be rated for frequency variation within plus/minus 5%.
- D. Specific motor data such as HP, rpm, enclosure type, etc, are specified under the detailed specification for the equipment with which the motor is supplied.
- E. Provide motors 1 horsepower and above with service factor of 1.15 at 40°C under sinusoidal operation unless specifically noted otherwise.

2.02 ENCLOSURES

- A. Motors specified herein will conform to one of the following NEMA standard enclosure designs:

1. Open Drip Proof (ODP): Motor shall be constructed with ventilated openings such that drops of liquid and solid particles striking or entering the enclosure at any angle 0 – 15 degrees downward from vertical do not interfere with the successful operation of the motor.
 2. Weather Protected Type I (WPI): A weather-protected Type I machine is a guarded machine with its ventilating passages so constructed as to minimize the entrance of rain, snow and air-borne particles to the electric parts.
 3. Weather Protected Type II (WP2): A weather-protected Type II machine shall have, in addition to the enclosure defined for a weather protected Type I machine, its ventilating passages at both intake and discharge so arranged that high velocity air and air-borne particles blown into the machine by storms or high winds can be discharged without entering the internal ventilating passages leading directly to the electric parts of the machine itself. The normal path of the ventilating air which enters the electric parts of the machine shall be so arranged by baffling or separate housings as to provide at least three abrupt changes in direction, none of which shall be less than 90 degrees. In addition, an area of low velocity not exceeding 600 feet per minute shall be provided in the intake.
 4. Totally enclosed fan cooled (TEFC) Motors shall have a steel or cast iron frame, cast iron end brackets, cast iron conduit box, drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and upgraded insulation by additional dips and bakes to increase moisture resistance. Fan for cooling the motor shall be integral.
 5. Totally enclosed non-ventilated (TENV): Motors shall include the same rating and accessories as specified for TEFC motors except that the frame surface is cooled by convention only.
- B. Motors shall have a steel or cast iron frame and a cast iron or stamped steel conduit box. Conduit box shall be split from top to bottom and shall be capable of being rotated to four positions. Synthetic rubber-like gaskets shall be provided between the frame and the conduit box and between the conduit box and its cover. Where available for the enclosure type specified, motor leads shall be sealed with a non-wicking, non-hygroscopic insulating material. A frame mounted pad with drilled and tapped hole, not less than 1/4-in diameter, shall be provided inside the conduit box for motor frame grounding.

2.03 SEVERE DUTY

- A. Where motors are specified to be "Severe Duty" per the technical specifications they shall be of the corrosion resistant type conforming to motors designated by the manufacturer as "Corro-Duty", "Mill and Chemical", "Custom Severe Duty", or similar quality designation. Severe duty motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box, tapped drain holes (corrosion resistant plug for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger).
- B. Motors shall be single speed, totally-enclosed fan-cooled (TEFC), squirrel-cage polyphase induction motors.
- C. Where fractional horsepower motors are specified in the process equipment specifications or shown on the Drawings for applications requiring severe duty

motors, provide nominal 1 horsepower severe duty motor conforming to manufacturer's standard severe duty equipment.

2.04 SPECIAL PURPOSE MOTORS

A. Submersible motors:

1. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for 180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum.
2. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection.
3. The motor shall include a moisture sensor that will detect when moisture has entered the stator and lower oil seal housing. The sensor shall send an alarm to a control panel, motor control center or as shown on the drawings.
4. The power and control cable entry shall be designed to provide a positive leak-free seal to prevent liquid from entering the air filled motor housing. Cable type shall be SEOW-A or Equal and be UL Listed for submersible use in sewage water.
5. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable.
6. The motor shall be explosion proof, TENV design and be certified for Class 1, Division 1, Groups C & D by Factory Mutual (FM).

B. Explosion proof motors

1. Explosion proof motors shall have a cast iron frame, cast iron end brackets, cast iron conduit box, 1.15 service factor at 40 degrees C, tapped drain holes (corrosion resistant plugs for frames 286T and smaller and automatic breather/drain devices for frames 324T and larger) and be UL listed for Class 1, Div. 1, Group D hazardous areas.

2.05 NAMEPLATES

- ### A.
- Provide motor manufacturer's nameplates engraved or embossed on stainless steel and fastened to the motor frame with stainless steel screws or drive pins. Nameplates shall indicate clearly all of the items of information enumerated in NEMA Standard MG1-10.38 or MG1-20.60, as applicable.

2.06 CONDENSATION HEATERS

- A. Provide condensation winding space heaters for every 3-phase motor provided under this Contract unless specified otherwise under the detailed equipment specifications. Heaters shall be of the cartridge or flexible wrap around type installed within the motor enclosure adjacent to core iron. Heaters shall be rated for 120 Volt, single phase with wattage as required or as recommended by the motor manufacturer for the specific application. The heater wattage and voltage shall be embossed on the motor nameplate. Power leads for heaters shall be brought out at the motor lead junction box or auxiliary termination box if available.

2.07 TEMPERATURE DETECTORS

- A. Provide stator winding temperature detectors for all motors 200 hp and larger, all motors 40 hp and larger when driven by variable speed drives, where specified under the detailed mechanical specifications for individual equipment, or where shown on the Drawings.
- B. Detector leads shall be terminated in the motor main conduit termination box or auxiliary termination box on the motor frame if available.

2.08 SINGLE PHASE MOTORS

- A. Unless otherwise specified, motors smaller than 1/2 Hp shall be single phase, capacitor start. Small fan motors may be split-phase or shaded pole type if such are standard for the equipment. Wound rotor or commutator type single-phase motors are not acceptable unless their specific characteristics are necessary for the application.
- B. Single-phase motors shall be rated for operation at 115 Volts, 208 Volts, or 240 Volts, single phase, 60 Hz, as shown on the Drawings.
- C. Locked rotor current shall not be greater than specified in NEMA Standard MG1, Part 12, Design "N".
- D. Motors shall be totally enclosed in conformance with NEMA Standard MG1, Part 1. Small fan motors may be open type if suitably protected from moisture, dripping water and lint accumulation.
- E. Motors shall be provided with sealed ball bearings lubricated for 10 years normal use.
- F. Motors shall be by Nidec-U.S. Motors; Baldor; GE Motors; or equal.

2.09 THREE PHASE MOTORS-FRAMES 143T THROUGH 449T

- A. General
 - 1. Unless otherwise specified, motors 1/2 Hp and larger shall be 3 Phase, squirrel cage induction type, premium efficiency.
 - 2. All motors 3/4 Hp and larger shall be a NEMA frame 143T or larger. 1/2 Hp motors and 3/4 Hp motors rated 1800 and 3600 rpm, shall be a 56 frame. Motors shall be designed and connected for operation on a 480 Volt, 3 Phase, 60 Hz alternating current system. Dual voltage (230/460) rated motors are acceptable.
 - 3. Unless otherwise required by the load, all motors shall be NEMA Design B, normal starting torque. Locked rotor kVA/Hp shall not exceed Code Letter G as described in NEMA Standard MG1-10.37 for motors 20 Hp and larger.

4. Motors one horsepower and above shall meet or exceed the requirements of IEEE 841.
5. Motors with a 180 frame and larger shall have provisions for lifting eyes or lugs capable of a safety factor of 5.
6. Motors shall be by Nidec-U.S. Motors; Baldor; GE Motors; or equal.

B. Bearings

1. Anti-friction motor bearings shall be designed to be regreasable and initially shall be filled with grease suitable to ambient temperature of 40 degrees C. Bearings shall be AFBMA Types BC or RN, heavy duty, or shall otherwise be shown to be suitable for the intended application in terms of B-10 rating life, Class M3 or better.
2. All grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with an easily accessible grease supply, flush, drain and relief fittings including an externally visible sight glass to view the oil level. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic type by the Alemite Division of the Stewart-Warner Corporation.
3. Grease lubricated bearings shall be designed for electric motor use. The grease shall be capable of higher temperatures associated with electric motors and shall be compatible with Polyurea-based greases.
4. Bearings shall be rated for a minimum of 26,280 hours L-10 life at full-load direct-coupled, except vertical high thrust motors.
5. Vertical motors shall be capable of withstanding a momentary up-thrust of at least 30% of normal down-thrust.

C. Insulation

1. Insulation systems shall be Class B (130 degrees C) and shall be manufacturer's premium grade, resistant to attack by moisture, acids, alkalis and mechanical or thermal shock. Maximum temperature rise by resistance at rated HP shall not exceed Class B limits (80 degree C)
2. For motors at 1.15 Service Factor, the maximum temperature rise by resistance shall not exceed Class F limits of 115 degree C.
3. Motors for severe duty service shall have vacuum/pressure impregnated epoxy insulation for moisture resistance.
4. Insulation for inverter duty motor windings shall meet or exceed the Pulse Endurance Index for magnetic wire and shall not be injured when exposed to repeated pulse type waveforms, repetitive high voltage transients, switching frequency and rate of rise of the pulse. Class H varnish shall be used.

D. Vibration

1. Vibration shall not exceed 0.15 inch per second, unfiltered peak.
2. maintenance without having to disassemble the motor and remove the rotor.
3. Shaft grounding device shall be manufactured by Sohre, Aegis or Equal.

E. Motor Efficiencies (Three Phase Motors)

1. Motor efficiencies shall meet the requirements of the Energy Independence and Security Act (EISA) and be manufactured to meet the following efficiency standards:
 - a. General purpose motors (subtype I) with a power rating of 1 Hp through 200 Hp shall have a nominal full-load efficiency that is not less than as defined in NEMA MG- 1 (2006) Table 12-12 (“NEMA Premium®”) efficiency levels. Subtype I motors include:
 - 1) Foot-mounted 3-digit frame sizes with C-face and foot mount
 - 2) Includes ODP, TEFC, TENV, explosion-proof, etc.
 - b. General purpose motor (subtype II), with a power rating of 1Hp through 200 Hp shall have a nominal full-load efficiency that is not less than as defined in NEMA MG-1 (2006) Table 12-11 (“Energy Efficient ®”) efficiency levels. Subtype II motors include:
 - 1) U-Frame motor
 - 2) Design C motor
 - 3) Close-coupled pump motor
 - 4) Footless motor
 - 5) Vertical solid-shaft normal thrust motor (tested in a horizontal configuration)
 - 6) 8-pole motor (900 rpm)
 - 7) Poly-phase motor with voltage of no more than 600 volts (other than 230 or 460 volts)
 - c. Fire pump motors shall have nominal full-load efficiency no less than as defined in NEMA MG-1 (2006) Table 12-11.
2. Efficiency values shall be based on tests performed in accordance with IEEE 112, Method B. Motors with horsepower or rpm's not listed shall conform to comparable standards of construction and materials as those for listed motors.
3. Where California laws dictate higher efficiencies than those listed, the higher efficiency motors shall be furnished.

F. Motor Power Factor Correction Capacitors

1. All single speed motors with across the line starting over 10 horsepower (i.e., excluding motors powered from variable frequency drives or reduced voltage starters) shall be provided with a UL listed, heavy duty industrial type power factor correction capacitor mounted at the motor.
2. Power factor correction capacitors shall be as recommended, selected, and furnished by the motor manufacturer to raise the motor power factor to approximately 95 percent.
3. For non-explosion-proof motors, the capacitor shall be mounted on the equipment base plate adjacent to the motor and shall be connected to the motor junction box with liquid tight flexible conduit. For explosion-proof motors, the capacitors shall be wall mounted in a non-hazardous area.
4. Capacitors shall be dry film or liquid insulated and shall be hermetically sealed in steel enclosures.

5. Each capacitor unit shall be furnished with three high interrupting capacity current limiting fuses. Fuses shall be equipped with "blown-fuse" indicators.
6. Capacitor enclosures shall be suitable for conduit connection. Covers shall be gasketed, bolt-on type.
7. Capacitors shall be UL listed.
8. Capacitors shall be by General Electric Co.; Square D Co. or equal.

**Table 12-11
NEMA Full-Load Efficiencies of Energy Efficient Motors¹**

OPEN MOTORS

Hp	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	--	--	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	84.0	81.5	75.5	72.0
2.0	84.0	81.5	84.0	81.5	85.5	82.5	85.5	82.5
3.0	84.0	81.5	86.5	84.0	86.5	84.0	86.5	84.0
5.0	85.5	82.5	87.5	85.5	87.5	85.5	87.5	85.5
7.5	87.5	85.5	88.5	86.5	88.5	86.5	88.5	86.5
10	88.5	86.5	89.5	87.5	90.2	88.5	89.5	87.5
15	89.5	87.5	91.0	89.5	90.2	88.5	89.5	87.5
20	90.2	88.5	91.0	89.5	91.0	89.5	90.2	88.5
25	91.0	89.5	91.7	90.2	91.7	90.2	90.2	88.5
30	91.0	89.5	92.4	91.0	92.4	91.0	91.0	89.5
40	91.7	90.2	93.0	91.7	93.0	91.7	91.0	89.5
50	92.4	91.0	93.0	91.7	93.0	91.7	91.7	90.2
60	93.0	91.7	93.6	92.4	93.6	92.4	92.4	91.0
75	93.0	91.7	94.1	93.0	93.6	92.4	93.6	92.4
100	93.0	91.7	94.1	93.0	94.1	93.0	93.6	92.4
125	93.6	92.4	94.5	93.6	94.1	93.0	93.6	92.4
150	93.6	92.4	95.0	94.1	94.5	93.6	93.6	92.4
200	94.5	93.6	95.0	94.1	94.5	93.6	93.6	92.4
250	94.5	93.6	95.4	94.5	95.4	94.5	94.5	93.6
300	95.0	94.1	95.4	94.5	95.4	94.5	--	--
350	95.0	94.1	95.4	94.5	95.4	94.5	--	--
400	95.4	94.5	95.4	94.5	--	--	--	--
450	95.8	95.0	95.8	95.0	--	--	--	--
500	95.8	95.0	95.8	95.0	--	--	--	--

Notes:

1. Values included in the table above were taken from the NEMA Standards MG 1-2006

**Table 12-11
NEMA Full-Load Efficiencies of Energy Efficient Motors¹**

ENCLOSED MOTORS

Hp	2 POLE		4 POLE		6 POLE		8 POLE	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	75.5	72.0	82.5	80.0	80.0	77.0	74.0	70.0
1.5	82.5	80.0	84.0	81.5	85.5	82.5	77.0	74.0
2.0	84.0	81.5	84.0	81.5	86.5	84.0	82.5	80.0
3.0	85.5	82.5	87.5	85.5	87.5	85.5	84.0	81.5
5.0	87.5	85.5	87.5	85.5	87.5	85.5	85.5	82.5
7.5	88.5	86.5	89.5	87.5	89.5	87.5	85.5	82.5
10	89.5	87.5	89.5	87.5	89.5	87.5	88.5	86.5
15	90.2	88.5	91.0	89.5	90.2	88.5	88.5	86.5
20	90.2	88.5	91.0	89.5	90.2	88.5	89.5	87.5
25	91.0	89.5	92.4	91.0	91.7	90.2	89.5	87.5
30	91.0	89.5	92.4	91.0	91.7	90.2	91.0	89.5
40	91.7	90.2	93.0	91.7	93.0	91.7	91.0	89.5
50	92.4	91.0	93.0	91.7	93.0	91.7	91.7	90.2
60	93.0	91.7	93.6	92.4	93.6	92.4	91.7	90.2
75	93.0	91.7	94.1	93.0	93.6	92.4	93.0	91.7
100	93.6	92.4	94.5	93.6	94.1	93.0	93.0	91.7
125	94.5	93.6	94.5	93.6	94.1	93.0	93.6	92.4
150	94.5	93.6	95.0	94.1	95.0	94.1	93.6	92.4
200	95.0	94.1	95.0	94.1	95.0	94.1	94.1	93.0
250	95.4	94.5	95.0	94.1	95.0	94.1	94.5	93.6
300	95.4	94.5	94.5	94.5	95.0	94.1	--	--
350	95.4	94.5	95.4	94.5	95.0	94.1	--	--
400	95.4	94.5	95.4	94.5	--	--	--	--
450	95.4	94.5	95.4	94.5	--	--	--	--
500	95.4	94.5	95.8	95.0	--	--	--	--

Notes:

1. Values included in the table above were taken from the NEMA Standards MG 1-2006

**Table 12-12
NEMA Premium Full Load Efficiencies¹**

OPEN MOTORS

Hp	3600 RPM		1800 RPM		1200 RPM	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	86.5	84.0
2.0	85.5	82.5	86.5	84.0	87.5	85.5
3.0	85.5	82.5	89.5	87.5	88.5	86.5
5.0	86.5	84.0	89.5	87.5	89.5	85.7
7.5	88.5	86.5	91.0	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93.0	91.7	91.7	90.2
20	91.0	89.5	93.0	91.7	92.4	91.0
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	94.1	93.0	93.6	92.4
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.0	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95.0	94.1
125	94.1	93.0	95.4	94.5	95.0	94.1
150	94.1	93.0	95.8	95.0	95.4	94.5
200	95.0	94.1	95.8	95.0	95.4	94.5
250	95.0	94.1	95.8	95.0	95.4	94.5
300	95.4	94.5	95.8	95.0	95.4	94.5
350	95.4	94.5	95.8	95.0	95.4	94.5
400	95.8	95.0	96.2	95.4	96.2	95.4
450	95.8	95.0	96.2	95.4	96.2	95.4
500	95.8	95.0	96.2	95.4	96.2	95.4

Notes

1. Values included in the table above were taken from the NEMA Standards MG 1-2006.

**Table 12-12
NEMA Premium Full Load Efficiencies¹**

ENCLOSED MOTORS

Hp	3600 RPM		1800 RPM		1200 RPM	
	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency	Nominal Efficiency	Minimum Efficiency
1.0	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5
2.0	85.5	82.5	86.5	84.0	88.5	86.5
3.0	86.5	84.0	89.5	87.5	89.5	87.5
5.0	88.5	86.5	89.5	87.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2	91.0	89.5
10	90.2	88.5	91.7	90.2	91.0	89.5
15	91.0	89.5	92.4	91.0	91.7	90.2
20	91.0	89.5	93.0	91.7	91.7	90.2
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	93.6	92.4	93.0	91.7
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.4	94.5	94.5	93.6
100	94.1	93.0	95.4	94.5	95.0	94.1
125	95.0	94.1	95.4	94.5	95.0	94.1
150	95.0	94.1	95.8	95.0	95.8	95.0
200	95.4	94.5	96.2	95.4	95.8	95.0
250	95.8	95.0	96.2	95.4	95.8	95.0
300	95.8	95.0	96.2	95.4	95.8	95.0
350	95.8	95.0	96.2	95.4	95.8	95.0
400	95.8	95.0	96.2	95.4	95.8	95.0
450	95.8	95.0	96.2	95.4	95.8	95.0
500	95.8	95.0	96.2	95.4	95.8	95.0

Notes

1. Values included in the table above were taken from the NEMA Standards MG 1-2006.

PART 3 - EXECUTION

3.01 GENERAL

- A. Install all motors in accordance with the manufacturer's printed recommendations and as required under the specific specification sections for the driven equipment.

3.02 INSTALLATION

- A. Motors shall be stored indoors in a clean, dry location with space heaters energized to preclude moisture buildup.
- B. Bolt the motor to the equipment or rigid foundation using bolts of the largest size permitted by the holes in the motor bracket. Do not install motors in such a way as to restrict motor ventilation.
- C. Motor enclosure type shall be used in the following locations unless otherwise specified in the technical specifications:
 - 1. ODP: Non-hazardous, relatively clean, dry, well ventilated area, indoors.
 - 2. WPI: Indoor/Outdoor, relatively clean area, minimal rain and snow.
 - 3. WPIL: Indoor/Outdoor, severe rain and snow, dirty environment.
 - 4. TEFC: Indoor/Outdoor, wet, dirty or dusty environment.
 - 5. TENV: Indoor/Outdoor, wet, dirty or dusty environment with well ventilated area and usually cooler temperatures.

3.03 FIELD QUALITY CONTROL

- A. Submit field test procedures for the Construction Manager's approval before testing begins. Test and submit test results for each motor.
- B. Field tests and inspections: Field testing shall be as specified in Section 16001.
- C. Submit field test procedures for City review and approval before testing begins. Test and submit test results for each motor.
- D. Testing shall conform to the requirements of the driven equipment Specifications to demonstrate compliance with the performance requirements specified.
- E. 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. 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.
- F. Compare equipment nameplate and data with drawings and specifications.
- G. Inspect physical and mechanical condition.
- H. Inspect for correct anchorage, mounting, grounding, connection, and lubrication.
- I. Perform system vibration testing where specified with the process equipment under Sections 11, 13, and 15.
- J. Verify the absence of unusual mechanical or electrical noise or signs of overheating during initial test run.
- K. Perform insulation resistance tests in accordance with ANSI/IEEE 43. Test duration shall be one minute. Calculate the dielectric absorption ratio.

- L. Verify that motor space heaters, where provided, are functional.
- M. Run each motor under normal operating conditions to demonstrate correct rotation direction, alignment, wiring size, proper overload relay sizing, speed, and satisfactory operation. Test interlocks and control features to verify correct wiring and operation.
- N. Measure and record motor current in each phase and include in the O&M manual. Repair or replace motor or driven-equipment if current exceeds motor nameplate value.

END OF SECTION

SECTION 16230

STANDBY DIESEL ENGINE - GENERATOR

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. The Contractor shall provide a complete factory assembled generator set and required supporting systems and materials as specified herein.
2. Provide factory test startup services and on-site testing of the system by a supplier authorized by the equipment manufacturer(s).
3. The Contractor shall provide the all coordination permitting for the new generator. Air quality permits and authorizations shall be obtained by the City.

B. Related:

1. Section 01612 – Seismic Design Criteria
2. Section 05500 – Metal Fabrications
3. Section 16001 – Electrical - General Provisions
4. Section 16442 – Motor Control Centers

1.02 REFERENCES

A. Design, manufacturing and assembly of elements of the equipment in these Specifications specified shall be in accordance with the following as specified. Where multiple revisions of a particular document are available, the current version at time of bid opening shall apply.

1. American National Standards Institute (ANSI)
 - a. ANSI S1.13 – Methods for Measurement of Sound Pressure Levels
2. American Society for Testing and Materials (ASTM)
 - a. ASTM A106 – Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
 - b. ASTM A36 – Standard Specification for Carbon Structural Steel
3. American Bearing Manufacturers Association
 - a. ABMA 20: Radial Bearings of Ball, Cylindrical Roller and Spherical Roller Types – Metric Design
4. Bay Area Quality Management District
 - a. BAAQMD, Rules and Regulations
5. Institute of Electrical and Electronics Engineers (IEEE)
 - a. IEEE C50.12 – Standard for Salient-Pole 50 Hz and 60 Hz Synchronous Generators and Generator/Motors for Hydraulic Applications Rated 5 MVA and Above
6. National Electrical Manufacturers Association (NEMA)

- a. NEMA MG1 – Motors and Generators
- 7. State of California, Department of Industrial Relations
 - a. California Code of Regulations, Occupational Safety and Health Administration (CAL-OSHA) – Title 8, Safety Orders
- 8. National Fire Protection Association (NFPA)
 - a. NFPA 110 – Standard for Emergency and Standby Power Systems
 - b. NFPA 70 – National Electrical Code
- 9. Underwriters Laboratories, Inc. (UL)
 - a. UL 142 – Steel Aboveground Tanks for Flammable and Combustible Liquids
 - b. UL 508A – Industrial Control Panels
 - c. UL 1236 – Battery Chargers for Charging Engine-Starter Batteries
 - d. UL 2080 – Fire Resistant Tanks for Flammable and Combustible Liquids
 - e. UL 2200 – Stationary Engine Generator Assemblies

1.03 SYSTEM DESCRIPTION

- A. The engine generator shall have continuous power ratings of not less than the kW shown on the Drawings at 80 percent lagging power factor at 480Y/277 volt, 3 phase, 4 wire, 60 Hertz.
- B. The engine generator shall be arranged for automatic starting and stopping and load transfer upon failure of the normal source of power as sensed and signaled from the automatic transfer switch specified in Section 16442.
- C. The engine generator package shall be complete in all respects and shall include all equipment and controls necessary for a fully operational system.
- D. The equipment to be furnished under this Section includes, but shall not be limited to the following:
 - 1. Skid mounted diesel engine and generator set.
 - 2. Weatherproof sound attenuated housing.
 - 3. Exhaust system.
 - 4. Double walled skid base fuel tank, including transfer piping, fill system, valves, leak detection system and appurtenances.
 - 5. Engine mounted alternator with skid mounted battery system.
 - 6. Spring vibration isolators for the support of the generator skid frame.
 - 7. Skid mounted engine generator control panel and appurtenances.
 - 8. Skid mounted generator circuit breaker.
 - 9. Skid mounted radiator and cooling fans.
 - 10. Radiator-mounted automatic load bank
 - 11. Spare parts and special tools.
 - 12. Field services, testing and training.

13. Warranty.

E. Performance requirements:

1. The voltage regulation shall be within plus or minus one percent from no load to full-rated load. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus .5 percent. Upon application or removal of full- rated load in one step, the transient voltage and recovery to steady state operation shall be within three seconds.
2. Frequency regulation shall be isochronous from steady state no load to steady state full load. Random frequency variation shall not exceed plus or minus 0.25 percent (0.15 Hertz).
3. The diesel engine-generator set shall be capable of load pick up of 100% nameplate kW and power factor, at site conditions, with the engine generator at the temperature as maintained by the engine water jacket heater.
4. Motor starting capability shall be as required by the loads indicated on the single line diagram. The engine generators shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
5. The engine generators shall be capable of starting the loads with a maximum of 20% starting voltage dip and frequency dip.
6. Emissions shall meet the requirements of Tier 3, U.S. EPA approved for emergency non road use.
7. The engine generator system shall be classed as an Emergency system.
8. The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples.
9. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.
10. The generator set, complete with sound attenuated enclosure, shall be tested by the generator set manufacturer per ANSI S1.13. Data documenting performance shall be provided with submittal documentation.

F. Noise Requirements

1. The generator shall be enclosed in a sound attenuated enclosure that achieves a dBA of not greater than 75 (nom) at 23 ft at full load at any point around the unit.

G. Equipment Anchorage Requirements

1. The Contractor shall design the anchorage for the generator set skid and submit calculations for review by the Engineer. Design shall account for seismic forces as noted in Section 01612.
2. Design shall be based on installation on the equipment concrete pad as included in the Contract Drawings.
3. The Contractor shall provide details of the anchor bolt type, size, and connections to engine-generator skids. The anchor bolts shall be 304 stainless

steel and designed specifically for equipment furnished under this Contract. Anchor bolts shall be as specified under Section 05500.

4. The Contractor will be responsible for providing anchorage systems and for installing the generator set skid.

1.04 SUBMITTALS

A. All submittals shall be in accordance with Section 01300.

B. Equipment submittals shall including the following:

1. Shop drawings, catalog cuts, internal wiring schematics and other materials required to completely describe the systems and equipment being furnished.
2. Identification, description and dimensions for each separately installed sub-assembly or piece of equipment and associated piping and electrical connection schematics.
3. Seismic anchoring information and calculations per Section 01612. Calculations shall be stamped and signed by a registered structural engineer in the State of California.
4. Performance specifications of all items of equipment.
5. Generator enclosure panel layout drawings showing location of control panel, instruments and access to generator equipment such as the radiator, batteries, etc. The layout drawings shall also include dimensions and paint finish specifications.
6. Layout drawings of the integral fuel tank, including leak detection equipment, fill point, valves, pressure switches, etc.
7. Submit information on the fuel tank and indicate that the outer shell shall have a volume of 110 percent.
8. Complete electrical, instrumentation, control and wiring diagrams of instrumentation and controls and electrical components. Specifically, the following is required:
 - a. Complete electrical circuit schematics, including generator control, alarms and power to all motors, accessories, and instruments furnished with the unit. Schematics shall include all termination points in each control panel. Wiring shall be identified by numbers and every termination point shall be assigned a number. Termination point number (including wire number) shall appear on the schematics for each wiring termination shown. Submit written description of the operational control theory with the schematics.
 - b. Complete external electrical interconnection diagrams detailing specific terminals of connection, conduit sizes, and required wire sizes.
9. Complete Operations and Maintenance Manuals, as required in Section 01782. The manual shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, as built wiring diagrams, etc. that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

C. Specific submittal information for the following components shall be included:

1. Engine Data
 - a. Manufacturer and Model

- b. Engine type
 - c. Number and arrangement of cylinders
 - d. Rated RPM
 - e. Governor type including make and model
 - f. Maximum power (kW) at rated RPM and site temperature and altitude conditions
 - g. Main bearings, quantity and type
 - h. EPA Tier 3 certification
 - i. Certification of Emissions for the engines, including data on particulate matter, precursor organic compounds (POC), non-precursor organic compounds (NPOC), nitrogen oxides (NOx), and carbon monoxide (CO).
 - j. Certification of Emissions for the engines, including data on particulate matter, precursor organic compounds (POC), non-precursor organic compounds (NPOC), nitrogen oxides (NOx), and carbon monoxide (CO).
2. Generator Data
- a. Manufacturer and Model
 - b. Generator type
 - c. Exciter type
 - d. Voltage regulator
 - e. Rated KVA
 - f. Rated KW
 - g. Voltage
 - h. Insulation rating and temperature rise data
 - i. Frequency
3. Generator efficiency, including excitation losses, at 80 percent PF
- a. Full load
 - b. Three-quarters load
 - c. Half load
4. Guaranteed fuel consumption rate (at 138,000 BTU/gallon)
- a. Full load, gal/hr
 - b. Three-quarters load, gal/hr
 - c. Half load, gal/hr
5. Generator unit, enclosure and accessories
- a. Weight of skid mounted unit including fuel and tank
 - b. Overall length
 - c. Overall width
 - d. Overall height

- e. Fuel tank details including construction, capacity, leak and fuel level detectors
 - f. Exhaust pipe size, silencer manufacturer and silencer attenuation curve
 - g. Size and locations of conduit stub-up areas.
6. Details of the battery system including calculations for sizing batteries that indicates compliance with battery load and environmental starting requirements listed herein.
 7. Dimensional drawings, Bill of Materials, color selection chips, and sound attenuation data for the weather proof sound enclosure.
- D. Operational Certification
1. Submit certification that each unit is guaranteed to be adequate for motor starting as required by this Specification.
 2. Factory test reports.
- E. Test Reports
1. Furnish copies of the certified shop test and field test records of the complete engine driven generator units.
- F. Air Emission Certification
1. The engine generator system shall comply with the particulate and combustion gas emission limits of the BAAQMD (Bay Area Air Quality Management District) in effect at time of bid. Coordinate permit requirements with the City. Any pollution mitigation devices or modifications required to permit the specified testing time shall be included in the Contract price.
 2. The Contractor shall provide all required backup documentation including risk assessment analyses, details of the engine and its components, etc., to the City that is required by BAAQMD for the air emission installation (Authorization to Construct) and operational permits (Permit to Operate) as obtained by the City.
 3. Provide all required backup documentation as required to achieve conformance with BAAQMD requirements.
- G. Manufacturer's recommendations for long-term storage of consumables, including specific types and grades of fluids, lubricants, filters, reagents, etc.

1.05 QUALITY ASSURANCE

- A. The engine generator shall be a standard product, as modified by these Specifications, of a manufacturer regularly engaged in the production of this type of equipment.
- B. The engine generator supplier shall be regularly engaged in the design and the installation of engine generator systems and their associated subsystems as they are applied to the municipal water or wastewater industry. The engine generator supplier shall be an organization that complies with all of the following criteria:
1. Maintains a permanent service organization and supply of spare parts in place at the time of the bid within 200 miles of the project site.
 2. Supplies service and warrantee work for the engine and generator portion of the unit with their own employees.

3. Employs design, fabrication, testing and field service personnel on this project who have successfully completed a manufacturer's training course on the specific engine generator set proposed for this project.
 4. Is an authorized distributor for the specified manufacturer of the engine and generator
 5. Furnishes a unit assembled from components with proven compatibility, reliability and are coordinated to operate as a unit.
 6. Owns and operates service trucks dedicated to the purpose of providing field service on the engine generator and associate components.
 7. Has performed work of similar or greater complexity on at least five previous projects.
- C. The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.06 MANUFACTURER'S FIELD SERVICES

- A. The generator manufacturer shall provide the field services of a factory technician as necessary to supervise/inspect installation, test and start-up all equipment provided as part of the price proposal. The price shall include all travel and living expenses in addition to the technician's time required to complete supervision of the installation, testing and start-up. All equipment required for testing, start-up and performance verification shall be provided by the manufacturer's technician.
- B. At a minimum the manufacturer shall provide the following technician person hours for each occurrence or listed field task:

Description	Person Hours
Inspection	8
Installation Assist	8
Settings, Adjustments	8
Start Up and Testing	8
Training	8

1.07 DELIVERY, STORAGE AND HANDLING

- A. After successful factory tests and other required milestones, the generator shall be stored at the Contractor's expense until the installation site is ready to accept shipment. The unit shall be stored at a storage facility acceptable to the City in accordance with all manufacturer's requirements for long-term storage. City shall have access to the unit during storage upon request.
- B. Ship equipment, material and spare parts to each site complete except where partial disassembly is required by transportation regulations or for protection of components.
- C. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

- D. Mechanical and electrical equipment shall be coated, wrapped and otherwise protected from snow, rain, drippings of any sort, dust, dirt, mud, flood and condensed water vapor during shipment and while stored before construction.

1.08 PROJECT/SITE REQUIREMENTS

- A. The engine generator and associated equipment shall be suitable for standby operation at the intended site condition in and around the City of East Palo Alto. The engine generator system shall be provided with a weatherproof sound attenuated enclosure and will be installed outdoors.

1.09 MAINTENANCE

A. Spare Parts

1. Provide the following spare parts per unit:
 - a. Two air filter elements.
 - b. Two lube oil filter elements
 - c. Two fuel oil filter elements
 - d. One set of hoses and belts including one of each different size and type.
 - e. Three complete replacement sets of fuses of each different size and type.
 - f. Two complete change of lube oil plus one gallon of make-up lube oil supplied in unopened containers.
 - g. Six pilot lamps of each type and voltage.
 - h. One quart of touch-up paint in each color used on the main assembly and housing.
2. The spare parts and maintenance tools shall be packed in containers, permanently labeled by word and part number for easy identification of the items and with the words "For Use Only for the __KW Diesel Engine Generator Unit installed at ____ Pump Station" (fill in rating and location) and properly packed for an extended period of storage before use.
3. Provide all manufacturer's recommended spare parts to support satisfactory operation over a 3 year period. Include any disposable parts, chemical refills, etc. as necessary to meet this requirement under normal expected operational conditions.

1.10 OPERATION AND MAINTENANCE MANUAL

- A. Manuals shall be as specified under Section 01782.
- B. Three copies of the Operation and Maintenance Manual shall be submitted for the engine generator system. Operation and Maintenance Manuals shall include successfully completed Factory and Field Test results for the engine generator system including the automatic transfer switch. The Operation and Maintenance Manuals shall be favorably reviewed as a requirement for final acceptance of the system. Favorable review status is 'No Exceptions Noted' or 'Make Corrections Noted'.

1.11 WARRANTY

- A. Provide manufacture's standard one year warranty.
- B. Warranty shall cover all system parts and labor.

- C. The generator set manufacturer shall warrant all equipment provided under this section, so that there is one source for warranty and product service. Technicians trained and certified by the manufacturer to support the product and employed by the generator system supplier shall service the generator sets.

1.12 MANUFACTURE'S

- A. Acceptable Engine Generator Manufacture's shall be:
 - 1. Caterpillar
 - 2. Cummins
 - 3. Kohler
 - 4. Or approved equal

PART 2 - PRODUCTS

2.01 GENERAL

- A. Equipment and controls specified in this Section shall be new and be considered part of the engine generator system; the Contractor shall be responsible for integrating and furnishing the system in its entirety as specified herein.
- B. The engine generator and related equipment shall be designed and constructed in conformance with the requirements of UL 2200, Engine Generator Assemblies.
- C. Mechanical equipment shall be designed and built for 24 hour continuous service at any and all points within the specified range of operation without overheating or excessive vibration or strain, and require only that degree of maintenance generally accepted as peculiar to the specific type of equipment required. Parts and components of all units shall be designed and built for interchangeability so that replacement parts may be installed without any additional fitting or machining.
- D. The engine generator systems shall allow easy access to the various parts for maintenance purposes. All parts shall be properly enclosed to prevent the throwing or dripping of oil.
- E. The engine generator systems shall be pre-piped and pre-wired insofar as possible.
- F. Provide terminals housed in an enclosure for connection of all remote alarm, control and status signals to and from the generator control panel as shown on the Drawings. Generator 480 VAC power output cables shall be connected directly to the generator output breaker terminals.
- G. All conductors shall be installed in rigid or flexible conduit as specified in Section 16120. Provide grounding bushings at conduit entrances to terminal boxes and enclosures on the unit.
- H. Supporting Structure: The diesel engine generator shall be directly bolted, doweled, and aligned on a rigid, fabricated steel base, suitably sized to maintain the correct alignment, supported by heavy duty spring type vibro isolators. For stationary units, isolators shall be suitable for anchoring to the level surface of a concrete pad.

2.02 RATING

- A. The generator set shall operate at 1800 rpm and at a voltage of: 277/480 Volts AC, three phase, 3-wire, 60 hertz.
- B. The complete generator set shall have kW rating per ISO8528 as shown on the Drawings at 0.8 PF, standby rating, based on site conditions of: 50-feet above sea

level, ambient temperatures of 40 degrees C, based on temperature measured at the control for indoor installations, and measured at the air inlet closest to the alternator for outdoor equipment.

- C. The generator set rating shall be based on Emergency Standby Power (ESP) use and marked as such per NFPA110.

2.03 EQUIPMENT

A. Engine and Governor

1. The engine generator set shall be a factory assembled unit, specifically designed and equipped for operation on No.2 diesel fuel oil with a radiator and fan cooled. The engine and generator shall be directly connected with a semi-flexible steel coupling, shall be free from injurious torsional or other vibration and shall be vibro-mounted to a heavy steel sub-base.
2. The diesel engine shall be six cylinders maximum, four stroke cycle, turbo-charged with minimum displacement of ___liters arranged for direct connection to an alternating current generator. The unit shall operate at a rotative speed of not more than 1800 rpm. Units offered at ratings in excess of their published ratings are not acceptable and will not be approved.
3. Governor shall be electronic, powered from the engine starting batteries and capable of maintaining isochronous regulation from no load to full rated load within 0.25 percent of rated frequency. It shall have the capacity for manual adjustment of speed setting and speed droop. Speed droop shall be adjustable from 0 to 5 percent from no load to full load. It shall be designed and installed to eliminate all electromagnetic interference and non sinusoidal waveforms.
4. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.
5. Furnish a separate overspeed shutdown device which shall, in case of predetermined overspeed or the operation of various protective devices as later specified, instantly stop the engine without the fuel injection system losing its prime.

B. Generator and Excitation System

1. The generator shall be of the open drip-proof bracket type, especially designed for connection to the engine and shall be for three phase, 60 Hertz, 4 wire, 480Y/277 volt operation. The generator shall have Class H insulation rated for 105 degree C temperature rise. The generator shall have Amortisseur windings.
2. The generator shall have a forged or cast alloy steel flanged shaft for direct connection through a suitable flywheel type coupling to the engine, or with suitable adapter and disc coupling and shall be of the single bearing type with anti-friction bearing.
3. The generator windings shall be braced to withstand short stresses and shall be designed to withstand overheating or stresses caused by harmonics generated by up to 15% non-linear loads. The unit influence shall be "Radio Interference Proof" (RIP) and the "Telephone Influence Factor" (TIF) shall be within the limits of Section 9, ANSI C50.12.

4. The generator shall be brushless with a rotating permanent magnet generator type exciter system, 3 phase solid state voltage regulator with filters and associated controls. Exciter shall have Class H insulation rated for Class F temperature rises.
5. The generator stator core shall be built of low carbon steel laminations, precision-punched, deburred and individually insulated. Stator coils shall be random wound and inserted in insulated core slots. Wound core shall be insulated. Armature lamination followers and frame ribs shall be welded integral with frame. Enclosure shall be drip-proof guarded.
6. Generator rotor poles shall be built up of individually insulated steel punchings. Poles shall be wet layer wound and insulated with VPI/epoxy resin. Cage connections shall be brazed for strong construction and permanent electrical characteristics. Each pole shall be securely bolted to rotor shaft.
7. A directional blower shall be mounted to draw cooling air from exciter end, over rotor poles and through louvered openings in drive end.
8. The generator shall have grease lubricated anti-friction bearings. The designed bearing life, based on B-10 curve of the Anti-Friction Bearing Manufacturers Association, shall be not less than 40,000 hours.

2.04 GENERATOR SYSTEMS

A. Diesel Fuel System

1. Each engine fuel injection system shall include replaceable element type fuel oil filters, integral fuel supply pump, and flexible connectors for both fuel supply and return piping.
2. The diesel fuel system shall include a base-mounted diesel storage tank with leak detection monitor, fuel piping and fittings and isolating ball valves as specified herein.
 - a. Tank capacity shall provide for 63-hour operation at full load at a minimum. The tank shall have dual shells (primary and secondary) with continuous welds and an annular space for monitoring leaks. The outer shell shall completely enclose the inner tank and have a volume of 110 percent of the inner tank. The tank piping and fittings shall meet the requirements of Uniform Fire Code 37, 79-7, 110, and UL142.
 - b. The tank shall be equipped with the following:
 - 1) Leak detection system with monitoring panel. Leak detector shall monitor the annular space between the walls of the fuel tank and shall include an auxiliary contact for remote alarm at the generator control panel.
 - 2) Tank low level alarm switch; tank low-low level alarm and shutdown switch.
 - 3) Fill assembly with 4-inch fill, cap, minimum 7-gallon UL-listed overflow/spill containment with automatic shutoff valve on overflow. There shall be a manual drain back to the main tank.
 - 4) Vent pipe and appurtenances. Vent package shall meet NFPA 30.
 - 5) Mechanical fuel level gauge.
 - 6) Electronic fuel level transducer and transmitter.

- c. The internal and external tank shall pass a 24 hour factory pressure test at pressure rating recommended by the tank supplier and applicable codes.
 - d. Fuel piping, fittings, and valve shall be Schedule 40 black steel or stainless steel tubing.
 - e. Provide isolating valves for the fuel lines at engine. The valve shall be ball type with lever handles, bronze and stainless steel construction suitable for diesel fuel service.
 - f. Provide pressure relief valve designed to limit fuel line pressure to a maximum of 2.5 psi. Relief valve shall vent outside the enclosure and oriented to avoid potential spraying of personnel with diesel fuel.
 - g. Provide fuel line check valve or other means to maintain prime in the fuel line and ensure immediate starting capability.
 - h. The tank shall be labeled "Diesel Fuel Only" and have the NFPA placard. An NFPA placard shall be placed on the enclosure door. H=0, F=2, R=0.
 - i. Tanks with a capacity of 660 gallons or less shall comply with UL subject 2080 Outline of Investigation for fire resistant, insulated tanks.
3. The engine driven fuel supply pump shall discharge through a series filtration system, consisting of a 10 micron particle removal cartridge, followed by a water separation cartridge. A pressure relief valve shall be furnished and installed upstream of the filters and arranged to discharge into the fuel tank. The excess fuel supplied to the engine shall be returned to the tank.

B. Electric (Battery) Starting System

1. Starting shall be accomplished by an engine mounted, solenoid shift electric starter, capable of withstanding four consecutive continuous cranking periods of 15 seconds duration each separated by 15 seconds rest periods before shutting down completely and providing an alarm to the control system.
2. The starting batteries shall be low maintenance, long life, lead calcium type, especially designed for diesel engine cranking service and of a capacity as recommended by the battery manufacturer for compliance to NFPA 110 starting requirements. The starting batteries shall be capable of cranking the engine being furnished, for the necessary break-away current as required and the spinning current for four consecutive starts of 15 seconds of cranking on each start, without being recharged, with the system at the site conditions. An insulated protective covering, skid mounted battery rack and suitable cables shall be provided. The rack shall be finished with an acid and fire resistant epoxy coating.
3. Cell containers shall be sealed, shock absorbing, heat resistant plastic with spray proof, flame arresting type vents. Battery shall be furnished with all connectors and hardware, lifting device, cables, and grease.
4. Battery charger shall be a UL 1236 listed device, fully automatic, filtered, float-type, charger suitable for mounting within the Generator enclosure. The chargers shall be designed for heavy-duty industrial service. The DC output shall be regulated to within one percent with plus or minus 10 percent fluctuations of the input voltage and shall be current limited at 120 percent of rated output.

5. Charge rate shall be temperature compensated to provide proper charging in ambient conditions from 20Deg C to plus 55Deg C.
6. The charger unit shall include DC ammeter and voltmeter, adjustable float and equalize controls, AC and DC circuit breakers, AC power failure alarm relay and low DC voltage alarm relay output contacts. Provide fault condition outputs per NFPA 110. Include LED indication of charger status, fault and equalize. LCD display shall include charge rate, battery voltage, configuration menu and commands.
7. Input voltage shall be a separate 120V AC power source as shown on the Drawings.

C. AC Alternator

1. The AC alternator shall be; synchronous, four pole, 2/3 pitch, brushless, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. The alternator design shall prevent shaft current from flowing and eliminate the need for insulated bearings. All insulation system components shall meet NEMA MG1 requirements for Class H insulation systems. Actual temperature rise measured by resistance method at full load shall not exceed 105Deg C in a 40Deg C ambient.
2. The alternator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage up to 5 percent above or below rated voltage.
3. The alternator shall be supplied with a dedicated, independent power source for the voltage regulation system, which provides sufficient excitation for the alternator to supply 300 percent of rated output current for 10 seconds.
4. The subtransient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.
5. Provide an anti-condensation heater for the alternator for generator sets installed outdoors or in unheated environments.

D. Air Intake System: The engine shall be equipped with suitably sized dry type air intake filter(s) to protect working parts of the engine from dirt and grit with replaceable type filter element. A crankcase breather shall be included.

E. Lubrication System: The engine shall be provided with a full pressure lubricating oil system arranged to cool the pistons and to distribute oil to all moving parts of the engine including the turbocharger bearings and including full flow filter of the replaceable element type and a suitably sized shell and tube type oil cooler and an automatic temperature regulator if required. An engine driven lubricating oil circulating pump shall be provided for the engine. This pump shall be of the positive displacement type, and shall have ample capacity to circulate the amount of lubricating oil and cooling oil required by the engine and turbocharger. The engine shall be provided with a sump type crankcase arrangement of sufficient capacity to suit the requirements of the engine.

F. Engine Cooling System: Skid-mounted radiator and cooling system rated for full load operation in 50 degrees C ambient as measured at the generator air inlet, based on 0.5 in H₂O external static head. Radiator shall be sized based on a core temperature which is 10C higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a

controlled environment. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with a 50/50-ethylene glycol/water mixture by the equipment manufacturer. Rotating parts shall be guarded against accidental contact.

G. Exhaust System

1. Exhaust silencer shall be of the critical grade type. The exhaust pipe shall be ASTM A106 with wall thickness of 0.250-in, black steel with flanged fittings and of the size recommended by the engine manufacturer. Suitable expansion joints shall be provided and installed where required to provide for expansion of the pipe caused by a 1000 degree F temperature change. The exhaust line shall be connected to the engine by a suitable section of flexible stainless steel metal exhaust corrugated tubing suitable for the maximum temperature condition which may be encountered. Exhaust line elbows shall be long radius.
2. Furnish and install suitable equipment for the engine exhaust to attenuate the sound as specified herein.
3. The exhaust silencer shall be factory mounted to the top or inside of the enclosure. The exhaust pipe shall terminate in a device to prevent the entrance of rain.
4. A suitable drain with valve shall be installed at the low point of the exhaust line.

H. Generator Output Circuit Breaker

1. The breaker shall be manually operated 3 pole, molded case circuit breaker, with solid state trip device. The frame and trip rating shall be as shown on the electrical single line drawings.
2. The circuit breaker shall have the following adjustments as a minimum: long time, short time and instantaneous (amps pickup and time delay) and ground fault (amps pickup and time delay).
3. The Contractor shall recommend the setpoints of the breakers based on the characteristics of the equipment furnished. Breaker interrupting ratings shall be suitable for the generator furnished, however shall be 25,000 AIC minimum.
4. The circuit breaker shall be UL listed to be applied at 100% of its rating.
5. The circuit breaker shall be housed in the NEMA rated enclosure mounted on the generator skid.

I. Weatherproof Acoustic Enclosure for Engine Generator Set

1. A weatherproof enclosure for the engine generator set and appurtenances shall be provided and shall be complete with locking access doors, fixed type louvers and screens, exhaust ventilators and screens, and other appurtenances as required for complete installation.
2. The enclosure shall be factory mounted to the engine generator skid base by the engine generator supplier and shipped to the site as an integral component of the generator system.
3. The enclosure shall be an all welded, formed sheet metal type, custom fabricated from ASTM A36 galvanized sheet steel. Wall and roof skin thickness shall be a minimum of 14 gauge panels be welded along 1 inch support flanges for added strength.

4. The access panels shall be constructed of 14 gauge galvanized sheet steel with same thickness as the wall panels and shall include hinged doors or a lift off feature to access all adjustable or maintainable components. The access panel hardware shall be zinc plated, and use a keyed alike 2-point locking system. The number and location of the access panels shall be provided as required to allow servicing of the engine generator unit.
5. Roof exhaust pipe opening and collar with rain cover shall be provided as required by the engine.
6. All electrical components internal to the enclosure shall be arranged to ensure conformance with NEC required minimum working space.
7. The enclosure shall be factory wired insofar as possible. Provide terminal boxes connection of all alarm, control and power conductors to the enclosure. Separate boxes shall be provided for 480 VAC, 120 VAC, and DC wiring as applicable. All conductors within the enclosure shall be installed in rigid or flexible conduit as specified in Section 16120. Provide grounding bushings at conduit entrances to terminal boxes and other panels on the unit.
8. The enclosure shall be hot steam or pressure cleaned to remove all oils and debris before applying the finish coatings. Sand and prep all metal surfaces, and seal all seams with a high quality sealer. The entire enclosure (interior and exterior) shall be primed, coated and finished with two coats of a high grade epoxy finish with a total dry film thickness of 10 mils or as recommended by the paint manufacturer. The color shall be as selected by the City.
9. Provide within the housing a 20 amp, 120 volt GFCI receptacle for maintenance purposes and a fluorescent light with manual light switch.
10. Housing shall be configured to allow installation of automatic load bank as specified herein. Installation of load bank shall not compromise the integrity of the enclosure materials, structure, mounting/anchoring, or acoustical performance.

J. Jacket Water Heaters

1. Automatic thermostatically controlled heater(s), rated 120 or 208 volt, single phase, shall be provided to maintain not less than 90 degrees F temperature with an ambient temperature of 25 degrees F for the engine jacket water.
2. Heaters shall be automatically deactivated when the engine generator unit is in operation.
3. A separate 120 or 208V power source shall be provided to the jacket heaters as shown on the Drawings.

2.05 GENERATOR CONTROLS

A. General

1. The engine generator shall include an integrally mounted engine generator control system. The components of this section shall be shop mounted inside of the weatherproof enclosure. If required by space or clearance constraints, components may be provided with individual NEMA 4 rated enclosures and shop mounted on the exterior of the overall generator enclosure or remotely where shown on the drawings. The controls shall include, but not be limited to, the following:

- a. Generator voltage regulator control potentiometer (the regulator may be located within the generator enclosure at the manufacturer's option).
 - b. 480-120/240 volt control power transformer (CPT) with 480 volt primary circuit breaker for the generator control panel and controls.
 - c. Battery charger.
 - d. Alarm and status annunciator system.
 - e. Engine start and stop controls.
2. The control system including the enclosure, covers, barriers, and supports shall be listed and labeled under the requirements of UL 508A.
 3. The generator set shall be provided with a microprocessor-based control system designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall be designed to allow local monitoring and control of the generator set. The control system shall also allow remote monitoring and control as described herein.
 4. Indicators, pilot devices, alarms and controls shall be housed in a control panel mounted within the generator enclosure. The control panel shall have nameplates adjacent to each device to identify the device's function. A wiring diagram shall be pasted to the inside of the door.
 5. Control system equipment shall be factory mounted and wired on or within the engine generator enclosure. Wiring shall be numbered in accordance with the numbering system used on the wiring/connection diagrams.
 6. Panel wiring shall be stranded copper conductor, 600 volt, insulation type SIS, or approved equal. Minimum size shall be No. 14 AWG for A.C. power wiring and No. 16 AWG for D.C. control wiring.
 7. Control relays and timers shall be heavy duty plug-in socket type with a transparent cover. The relays shall have 10 ampere minimum and 120/230VAC contacts. The mechanical life of the relay shall be 10,000 operations minimum.
- B. Control Functions and Components
1. As a minimum, the control system shall contain the following components and functions.
 - a. Generator output frequency meter, ammeter and voltmeter. The voltmeter and ammeter shall display all three phases. Output display shall be digital in either LED bar graph or LCD.
 - b. Running time meter and start counter.
 - c. Engine generator mode selector switch: The controls shall include a three-position RUN-OFF-AUTO switch. In RUN, the engine shall start and run without load transfer; in OFF, the engine shall stop and will not start; in AUTO, the engine shall start and run and stop from the remote engine start contact provided by hardwired contact from the automatic transfer switch.
 - d. Reset push-button with indicator. Indicator shall flash to indicate that generator set is locked out due to a fault condition.

- e. Lamp test push-button. Operation of this push-button shall cause all lamps on the panel to be simultaneously tested. As an alternative, provide push-to-test type pilot lights or digital indicators.
- f. Emergency Stop push-button. The emergency stop push-button shall be a red, mushroom head push-button which maintains its position until manually reset.
- g. Precision voltage and frequency adjust raise/lower switches or potentiometers. Switches (or potentiometers) shall allow the generator set frequency and voltage to be adjusted plus or minus 5%. Voltage and frequency adjustment switches shall be located inside of the control panel or shall be sealed in a manner to prevent unauthorized adjustment.
- h. Provide local operator interface panel with Alpha-numeric display with pushbutton access for viewing engine and alternator data and providing setup controls and adjustments.
- i. Alarm and Status Panel
 - 1) Provide and install a LED alarm and status annunciator panel or graphical interface panel as part of the generator control panel.
 - 2) Annunciator lamps shall be high-intensity LED type. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Label the annunciator status and alarm points in a fashion consistent with the specified functions shall be provided. Provide alarm lamp test switch.
 - 3) Graphical interface panel shall be color, touch screen with control keypad, minimum 12-inch screen size. Graphic screens shall be developed specifically for this project.
 - 4) Alarm horn or audible buzzer shall not be provided.
 - 5) The following alarm, shutdown, and status conditions are required, at a minimum:

Function	Alarm	Shutdown	Status
Low DC Voltage	*	-	-
High DC Voltage	*	-	-
Battery Charger AC Malfunction	*	-	-
Low Oil Pressure	*	*	-
High Oil Temperature	*	*	-
Fuel Tank – Low Level	*	-	-
Fuel Tank – Leak	*	-	-
Not in Auto	*	-	-
Low Water Jacket Temp	*	-	-
High Water Jacket Temp	*	*	-
Low Coolant Level	*	-	-

Function	Alarm	Shutdown	Status
High Coolant Temp	*	*	-
Overcrank		*	-
Fail to Crank	-	*	-
Overspeed		*	
Under Frequency	*	*	-
Under Voltage	*	*	-
Over Voltage	*	*	-
Emergency Stop In Automatic	*	*	*
Generator Running	-	-	*

- j. Engine status monitoring shall be available from a digital display panel on the generator set control of integrated into the graphical interface panel:
- 1) Engine oil pressure (psi or kPA)
 - 2) Engine coolant temperature (degrees F or C)
 - 3) Engine oil temperature (degrees F or C)
 - 4) Engine speed (rpm)
 - 5) Number of hours of operation (hours)
 - 6) Number of start attempts
 - 7) Battery voltage (DC volts)
- k. Engine Control Functions
- 1) The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
 - 2) The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
 - 3) The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
- l. Engine warning conditions shall be grouped to provide a common alarm. All shutdown alarms shall be grouped to provide a common alarm. Provide a status indication for generator run status. These items shall be available for remote monitoring via the network communications to the facility control system as specified under Section 13410.

- m. Complete engine start control which operates on closing contact and stop control which operates on hardwired contact from the remote Automatic Transfer Switch (ATS) specified under Section 16442.
 - n. Cranking limiter to disconnect the starting motor from the battery supply after completing a total of four 15 second cranking periods separated by 15 second rest periods before shutting down completely and alarming.
 - o. AC over/under voltage monitoring system which responds only to true RMS voltage conditions. The system shall initiate alarm and shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown and alarm shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
 - p. Battery monitoring system which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine starting, the low voltage limit shall be disabled.
 - q. Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.
 - r. Controls shall be provided to individually monitor all three phases of the output current for 1, 2, or 3-phase short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown).
 - s. Controls shall be provided to monitor the kW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.
- C. DC Control Power
- 1. Control power for the system shall be derived from the generator set starting batteries.
- D. Provide network communication module to allow real time communication with the generator set control by remote devices. The control shall communicate all engine and alternator data; alarm, shutdown and status conditions; and allow starting and stopping of the generator set via the network in both test and emergency modes.
- E. Door Switch
- 1. Heavy duty, limit switch, single pole single throw with mechanical snap switch mechanism.
 - 2. UL listed

3. Switch shaft sealed to ensure dust and water tight switch having enclosure rating of NEMA 13.
4. NEMA A600 switch rated 600V, 10A continuous duty; configurable for clockwise or counterclockwise configuration.
5. Snap action with silver alloy contacts and screw type terminal clamps.
6. Provide switch and roller arm at each enclosure door with normally closed contact for monitoring MCC intrusion, wired in series with other normally closed door switch contacts to the facility PLC as shown on the Drawings.
7. Square D, Series 9007, Honeywell, or approved equal.

F. Remote Monitoring

1. Form "C" dry contacts rated 2 A at 120VAC for Run status.
2. Form "C" dry contact set rated 2A @ 120VAC for composite alarm or shutdown condition.
3. One set of contacts rated 2A @ 120VAC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
4. A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
5. A fused 20 amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.

2.06 AUTOMATIC INTEGRAL LOAD BANK

- A. The resistive load bank shall be the engine radiator mounted, airflow cooled type. The load bank shall be designed for manual control. The load bank shall bear the mark of UL. The load bank shall be rated for 50 KW, 480 volts, 3-phase, 3 wire, 60 Hz, with load stepping each rated at 5 KW.
 1. Radiator-mounted load bank
 2. Load bank control panel
- B. The load bank system shall include all resistive load elements, load control devices, load element branch circuit fuse protection, main load bus and terminals, control terminals, system protection devices and NEMA rated 1 enclosures.
- C. Load elements shall be UL listed, labeled or recognized, Simplex Powr-Web Open wire or equal, helically wound, chromium alloy. Element wire shall be mechanically supported over entire length such that if a wire should break, the broken wire segments will not short to adjacent conductors or to ground. Load elements shall be individually serviceable and replaceable in the field without major disassembly of the load bank.
- D. A local control panel with an on-board PLC and a color touchpanel HMI shall be provided for control of the load bank, with the following controls:
 1. Control power on-off pushbuttons
 2. "Normal operation" indicator lamp
 3. Master load control switch

4. Load step control switches
5. "Cooling failure" alarm indicator lamp

E. Load Bank shall be Polaris, Simplex; Avtron, Emerson, or approved equal.

2.07 SURFACE PREPARATION AND SHOP PAINTING

A. Each engine generator and associated equipment shall be shop primed and finished coated per the manufacturer's standard practice prior to shipment.

PART 3 - EXECUTION

3.01 FACTORY TESTS

- A. The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. All testing shall be performed with calibrated metering.
- B. Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include at a minimum:
 1. Run at full load
 2. Maximum power
 3. Voltage regulation
 4. Transient and steady-state governing
 5. Single step load pickup
 6. Function of safety shutdowns
- C. A certified test report shall be provided with the generator set.

3.02 SHOP TESTS

- A. Before shipment to the project site, the engine generator system, including generator control panel shall be shop tested. Tests shall be performed at the supplier's service shop. Provide advanced notification to allow testing, at City option to witness the test. The City shall be notified at least two weeks prior to the proposed testing dates.
- B. The supplier shall have successfully performed their own quality assurance adjustments, tests and checks prior to requesting the witnessed shop tests. The purpose of the witnessed shop test shall be to demonstrate unit performance and conformance with all Contract requirements and shall not be utilized to perform routine adjustments or modifications to the unit.
- C. Shop tests for the system shall be sufficient to demonstrate that the system will operate successfully and meet all specified operational requirements.
- D. The supplier shall furnish all necessary instruments, filters, starting air, fuel, cooling water, electric power and load banks for the test.
- E. During shop testing, all automatic safety and shutdown devices shall be tested and their respective activation points shall be recorded.
- F. Voltage and frequency regulation and transient response shall be tested and recorded to show full compliance with this Section. Strip chart graphs of the response upon application of the generator rated load in a single step shall be

submitted with the test documentation. The chart shall be annotated to indicate the calibration of each axis. The transient response shall be demonstrated and recorded a minimum of three (3) times. The initial transient test shall be performed with a cold engine. The final transient test shall be performed on the engine at the completion of the four hour load test.

- G. The Shop Test shall consist of, but not be limited to, four continuous hours of operation. During the Shop Test, readings shall be taken and recorded every thirty minutes for each of the following parameters at a minimum:
 - 1. Time
 - 2. Ambient temperature
 - 3. Under no load conditions: Volts for each phase
 - 4. Under loaded conditions:
 - a. Amps for each phase
 - b. Voltage for each phase
 - c. KW
 - d. Power factor
 - e. Frequency
 - f. Engine jacket water temperature
 - g. Cooling water temperature (in and out)
 - h. Lubricating oil pressure
 - i. Lube oil temperature
 - j. Exhaust gas temperature
 - k. Gallons of fuel consumed per hour
- H. Shop test shall include sound tests.
- I. After completion of the Shop Test, the supplier shall perform the following:
 - 1. The load limit shall be sealed. The seal shall be applied, using a seal press which embosses the manufacturer's initials on the lead seal.
 - 2. All entrapped water shall be drained, and protection applied to prevent the entry of water during shipment or a long period in storage while waiting for installation.
 - 3. The engine generator shall be given proper treatment for its protection for extended storage while waiting for the installation contract.
- J. Certified test records for the generator system shall be submitted to the City for review. Systems shall not be shipped to the installation sites unless results have been given 'No Exceptions Noted' or 'Make Corrections Noted' status. The testing shall be repeated and certified results resubmitted for review at no extra cost to the City as often as necessary for the test results to be considered 'No Exceptions Noted' or 'Make Corrections Noted' by the City.
- K. Beginning at the time when the Shop Tests have been completed and favorably reviewed, the supplier shall make the engine generator systems available for delivery to the Contractor.

3.03 INSTALLATION

- A. Equipment shall be installed by the Contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- B. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The Contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- C. Equipment shall be installed on concrete housekeeping pads. Equipment shall be anchored to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- D. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.
- E. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- F. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.04 DELIVERY OF EQUIPMENT

- A. The Contractor shall deliver the engine generator system to the installation site when scheduled by the Construction Administrator. The Contractor shall pay all costs of delivery to the installation site, and the Contractor will provide equipment and labor for unloading the engine generator at the installation site.

3.05 FIELD SERVICE TECHNICIAN

- A. The Contractor shall coordinate, assist, place into operation, and certify the installation of the generator set.
- B. The engine generator supplier shall provide a one work-day minimum (8 hours) to assist the Contractor with installation of the engine generator system. Assistance shall include location of anchor bolts; setting, leveling and field erection; and coordination of electrical connections.
- C. The supplier shall provide the services of an onsite service technician for two work-day, minimum (16 hours), for the installation of the engine generator system start-up, testing, and calibration. Minimum work-day requirements listed are exclusive of travel time and do not relieve supplier of obligation to provide sufficient service to place equipment in satisfactory operation.
- D. Operation and maintenance instruction shall be as described in this Section.

3.06 FIELD START-UP AND TESTS

- A. Field start-up and testing shall be provided for the engine generator system by the supplier. Field start-up and testing will be a joint effort with the Contractor as necessary to assure that the system functions as specified. All tests shall be

performed in the presence of the City. After the supplier's field service technician's check of the installed system, the engine generator system shall be tested to demonstrate its ability to operate continuously without vibration, jamming, leakage or overheating and to perform specified functions. During start-up and operation, the Contractor will comply with the manufacturer's operating and maintenance instructions.

- B. The Field Test shall consist of two separate steps, the engine generator Load Test and the Power System Test. The Load Test shall demonstrate the capability of the installed engine generator and related systems to produce rated power and operate in accordance with manufacturer's recommendations. The Power System Test shall demonstrate the capability of the installed engine generator system to function as a part of the power system.
- C. Load test:
 - 1. Test duration shall be for four continuous hours at the full rated load of the engine generator unit.
 - 2. Supplier shall use the generator's radiator-mounted integral resistive load bank for this test.
 - 3. During the test, all parameters recorded during the Shop Test shall be taken and recorded at 30 minute intervals.
 - 4. During the test, all of the automatic shutdown devices shall be retested and the actuation values shall be recorded. Field adjustments shall be made as required to make the operating values correspond to those recommended by the engine generator manufacturer and as recorded during the Shop Test.
- D. Power system test:
 - 1. After the field Load Test has been completed, additional testing shall be performed by the supplier to demonstrate the power supply system's ability to meet the motor starting requirements. Field testing to demonstrate generator automatic start, load "stepping" and load transfer will be performed by the Contractor at the same time.
 - 2. The engine generator system shall be tested by the supplier to demonstrate the automatic startup, transient response, load carrying, cool down and shutdown modes of operation.
- E. Provide a pressure test port with threaded plug in the double wall piping termination fitting of each double wall fuel oil line or tank. Containment structures and piping shall be subjected to an air test of 10 psig with a zero allowable leakage rate.
- F. If the power supply system fails to fulfill the performance requirements of this specification, corrective action shall be taken and the system retested to assure full compliance. Expenses associated with the field tests, including any corrective action, shall be at no additional cost to the City.
- G. The Contractor will be responsible for all fuel and other fluids required by the diesel driven generator for the field tests and will refill the tank on completion of testing.

3.07 TRAINING

- A. Training for the engine generator system shall be complete as a condition for Substantial Completion.

- B. The training shall include how to operate the generator set and all equipment related to the generator including the switchover equipment. Maintenance instructions shall be included in the training session including troubleshooting and use of equipment specific diagnostics. Location for the training shall be coordinated with the City.

END OF SECTION

SECTION 16272

DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included

1. Distribution transformers shall be provided where shown on the Drawings, single-phase or three-phase and with rated kVA.

1.02 RELATED WORK

A. Section 16001 – Electrical - General Provisions

1.03 SUBMITTALS

A. Submittals shall be made in accordance with Section 01300 and Section 16001.

B. Submit the following for review:

1. Manufactures literature including equipment data sheets.
2. Plan, front, and side view drawing including overall dimensions, weights, and anchoring details
3. Load center schedules for each load center showing circuit allocations, breaker rating, spare, short circuit and bus ratings
4. Equipment seismic qualifications and anchorage details; provide seismic calculations for units greater than 400lbs conforming to Section 01190 as appropriate
5. Mounting bracket design for wall-mount applications
6. Installation and O&M manuals
7. Certified factory test reports

1.04 REFERENCES

A. American National Standards Institute

1. ANSI Z55.1: Gray Finishes For Industrial Apparatus and Equipment

B. Institute of Electrical and Electronics Engineers (IEEE)

1. IEEE C57.12.01: Standard General Requirements for Dry-Type Distribution and Power Transformer
2. IEEE C57.110: Recommended Practice for Establishing Transformer Capability When Supplying Non Sinusoidal Load Currents

C. National Electrical Manufacturers Association (NEMA).

1. TP-1: Guide for Determining Energy Efficiency for Distribution Transformers.
2. TP-2: Standard Test Methods for Measuring the Energy Consumption of Distribution Transformers.
3. ST-20: Dry Type Transformers for General Applications

- D. Underwriters Laboratories (UL)
 - 1. UL 1561: Standard for Dry-Type General Purpose and Power Transformers
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Provide transformers as manufactured by:
 - 1. General Electric
 - 2. Eaton Corporation/Cutler-Hammer
 - 3. Square D
 - 4. Approved equal

2.02 DISTRIBUTION TRANSFORMERS

- A. Transformers shall be designed, manufactured and tested in accordance with applicable ANSI, NEMA and IEEE standards and shall be UL listed.
- B. Transformer shall be NEMA TP-1 compliant, energy efficient for kVA rating 15kVA and higher.
- C. Transformer shall be of the two winding, self cooled type with kVA ratings as indicated on the drawings.
- D. Insulation system shall be a 220°C (Class R) winding insulation system with 115°C rise and be capable of 15% continuous overload. Performance shall be based on 40°C ambient.
- E. Coils shall be wound of electrical grade copper and be continuous wound construction. Basic Impulse Level shall be 10kV.
- F. Transformer shall be mounted within the motor control center specified in 16442.
- G. Sound level shall not exceed the NEMA ST-20 maximum average sound level for dry type transformers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install assembly on concrete housekeeping pad or wall mounted support system as shown on the on the Drawings. Provide vibration-absorbing pads and securely anchor the unit to the base or wall to minimize sound transmission.
- B. Transformer shall be properly anchored in accordance with the approved anchoring calculations conforming to the seismic requirements as specified in Section 01190.
- C. Make final conduit connections using suitable flexible conduit as specified in Section 16130 for equipment subject to vibration and for reducing noise transmission through the conduit system.
- D. Transformer neutral grounding shall be sized as shown on the Drawings. Make connections to the facility ground grid as shown on the Drawings and conforming to the NEC for separately derived systems.

- E. Maintain a maximum 12" and a minimum of 6" separation from building structure for heat dissipation.
- F. Provide permanent nameplate on the transformer indicating location of the disconnecting if remotely mounted from the unit.

3.02 FACTORY TESTS

- A. Transformer shall be tested in accordance with IEEE C57.12.01:
 - 1. Resistance measurements of all windings on the rated voltage connections and on all tap connections of each transformer
 - 2. Ratio tests on the rated voltage connections and on all tap connections
 - 3. Phase relation and polarity tests on the rated voltage connection
 - 4. No-load losses and excitation current at rated voltage on the rated voltage connections
 - 5. Impedance and load losses at rated current and rated frequency on the rated voltage connections of each transformer
 - 6. Potential tests
 - 7. Regulation and Efficiency at rated load and voltage
 - 8. Insulation resistance tests for high voltage to ground, low voltage to ground, and high voltage to low voltage
 - 9. Temperature tests

3.03 FIELD QUALITY CONTROL

- A. Site Tests, Inspections: acceptance testing shall be as specified in Section 16001.
- B. Adjust primary taps so that secondary voltage is within 2 percent of rated voltage.

END OF SECTION

SECTION 16440

SWITCHBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish, install and test the switchboards as shown on the Drawings in accordance with these Specifications.
2. Switchboards shall be sized to include all equipment, spares and spaces as shown on the Drawings.
3. The Contractor shall coordinate the size of the switchboard foot print with the size of the equipment pad.
4. The Contractor shall provide anchorage calculations as specified herein.
5. Switchboard shall include metering and pull section and be coordinated with the power company requirements as described in Section 16000 and as shown on the Drawings.

B. Related sections:

1. Section 01612 – Seismic Design Criteria
2. Section 01614 – Wind Design Criteria
3. Section 16001 – Electrical - General Provisions

1.02 QUALITY ASSURANCE

- A. The switchboards shall be the product of a manufacturer who shall also be the manufacturer of all the circuit breakers and fused switches included in the switchboards.
- B. All units and sections shall be UL labeled. Switchboards containing service entrance equipment shall be UL labeled "Suitable for Use as Service Equipment".

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01300.
- B. The Contractor shall furnish submittals for approval as outlined below:
 1. Manufacturer's equipment shop drawings showing elevation, dimensions and plan views including anchorage pattern. The drawings shall show compartment arrangement, weight and shipping splits.
 2. Single line diagrams, point-to-point compartment wiring diagrams for metering, relay and control circuits. Show wire and terminal numbers.
 3. Bus material, ratings and insulation details.
 4. NEMA rating of enclosure.
 5. Product data sheets and catalog numbers for circuit breakers and fused switches. List all options, trip adjustments, and accessories furnished specifically for this project. Submit time current characteristic curves for each protective device provided.

- 6. Itemized bill of material for metering, protective relays, accessories and control equipment.
- C. Submit anchoring calculations for the actual equipment being provided per the requirements of Section 01612 and Section 01614.
- 1.04 DELIVERY, STORAGE AND HANDLING
 - A. Refer Section 16001.
- 1.05 REFERENCE STANDARDS
 - A. The switchboards shall be designed, built, and tested in accordance with the latest editions and revisions NEMA Standard PB-2, and Underwriters' Laboratories (UL) Standard No. UL-891. Switchboards shall also comply with any applicable ANSI and IEEE Standards and the requirements of the National Electric Code (NEC).
 - B. UL 489, Molded Case Circuit Breakers
 - C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- 1.06 SPARE PARTS
 - A. Provide the following spare parts in the quantities specified for the switchboards:
 - 1. One dozen each size of cover bolts, cage nuts and door fasteners.
 - 2. Six cans of aerosol touch-up paint.
 - 3. 50 percent replacement fuses, all types and sizes.
 - 4. Two of each color replacement lens caps for pilot lights.
 - B. Spare parts shall be boxed or packaged for long term storage. Identify each item with manufacturers name, description and part number on the exterior of the package.
- 1.07 MANUFACTURER'S FIELD SERVICES
 - A. Installation
 - 1. Manufacturer's representative shall be present at the site for a minimum of [4] hours for assistance, startup, testing and certification. Travel time not included.
 - B. Testing.
 - 1. The manufacturer's service technician shall provide calibration, inspection and adjustments per the requirements of Section 16001.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The switchboard shall be front accessible deadfront type and shall have individually mounted main breaker. The switchboard and components shall be of the same manufacturer.
- B. Isolated compartments shall be provided for main circuit breaker device and metering equipment.
- C. A cable pull section shall be furnished where shown on the Drawings.
- D. The switchboard shall be service entrance rated.

2.02 SWITCHBOARD

A. Ratings.

1. Service: As shown on the Drawings.
2. The switchboards and protective devices shall be fully rated for a short circuit current of 65,000 rms symmetrical amperes or as shown on the Drawings, whichever is greater. Systems employing series connected ratings shall not be used.
3. The manufacturer shall design the switchboard, including devices, for continuous operation at its rated current in a 40 degree C ambient temperature.
4. Switchboards shall be UL listed.

B. Construction.

1. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.
2. Side, top and rear covers shall be code gauge steel, bolted to 12 gauge frame structure members. Front doors shall be flush, hinged, with screw fasteners.
3. Switchboard Service Entrance sections shall comply with UL Service Entrance requirements including a UL service entrance label, incoming line isolation barriers, neutral disconnecting link, and a main bonding jumper that bonds the neutral bus to the switchboard ground bus for solidly grounded wye systems.
4. All metal surfaces shall be chemically cleaned and primed. The finishing coat of paint shall be ANSI Z55.1 No. 61, light gray enamel.
5. NEMA 3R non-walk-in construction shall be as listed below:
 - a. Consist of standard indoor cubicles with a front frame and roof assembly to provide a weather resistant structure. Filtered front and rear roof vents. Front hinged doors with 3 point catch with padlocking provision and wind stop. Bolted rear covers.
 - b. Provide space heaters with thermostatic control. Space heaters shall be fed from separate source as indicated on drawings. Supply voltage shall be 120V AC.
 - c. Provide enclosure with sloped roof.
6. Incoming Section
 - a. Incoming section shall be utility pull section.
 - b. Furnish switchboard(s) arranged for bottom entry of incoming cable.
 - c. Provide mechanical lugs in the quantity and size required per the contract drawings. All lugs shall be tin-plated aluminum and UL listed for use with copper cable. Lugs shall be rated for 75 degree C. Cable.
7. Utility Metering Section
 - a. Provide utility metering section. Pull section and metering compartment shall comply with EUSERC and PG&E requirements.

- b. Compartment shall be barriered from the rest of the section, have a hinged lockable front cover, removable bus links with provisions for mounting current transformers, and when required, provisions for mounting voltage transformers. Current and voltage transformers shall be supplied and installed by the utility company.

C. Buses

1. All buses shall be silver-plated copper. The bus bars shall have sufficient cross sectional area and separation to meet UL 891 temperature rise and insulation requirements.
2. Buses shall be braced for the specified equipment short circuit current rating, but in no case less than 65KA rms symmetrical.
3. All bus joints shall be connected with high tensile steel bolts and conical spring-type or Belleville washers.
4. Provide a copper ground bus sized to meet UL 891 extending throughout the entire length of the switchboard, equipped with lugs for external ground connections, sized for cables shown on the Drawings.
5. Unused spaces, or spaces indicated for future devices shall include doors, bus, device supports or mounting plates and connections.
6. Main horizontal bus bars shall be standard tapered per UL.

D. Manufacturers:

1. Eaton Cutler-Hammer, Pow-R-Line C.
2. General Electric, Spectra Series.
3. Square D/Schneider Electric
4. Approved equal.

2.03 COMPONENTS

A. Circuit Protective Devices

1. Acceptable Manufactures:
 - a. Eaton Cutler Hammer, Series C
 - b. General Electric, Spectra RMS or Power Break II (Power Break II used for 1200A and larger only)
 - c. Square D/Schneider Electric
 - d. Approved equal.
2. Device trip setting and frame rating shall be as shown on the Drawings.
3. Main circuit breaker shall be individually mounted molded case circuit breaker. Circuit breakers shall be listed to UL489, 3 Pole, 600 Volt, 100 percent rated, bolt-on type with electronic trip device. Provide with ground fault protection for services greater than 1000A per NEC. Interrupting rms symmetrical ampere rating shall at minimum be 65.
4. Molded case circuit breakers
 - a. Individually mounted molded case circuit breakers shall be stationary mounted.

- b. Circuit breaker frames shall be constructed of a high-strength, molded, glass-reinforced polyester case and cover. Breakers shall have an over-center, toggle handle-operated, trip free mechanism with quick make, quick break action independent of the speed of the toggle handle operation. The design shall provide common tripping of all poles. Breakers shall be suitable for reverse feeding.
 - c. Breakers shall have ON and OFF position clearly marked on escutcheon. Breakers shall include a trip-to-test means on the escutcheon for manually tripping the breaker and exercising the mechanism and trip latch.
 - d. Breakers shall include factory installed mechanical lugs. Lugs shall be UL listed and rated 75 or 60/75 degrees C as appropriate. Breakers shall be 80 percent rated.
 - e. Breakers shall use digital true RMS sensing trip units and a rating plug to determine the breaker trip rating.
 - f. Circuit breaker shall be UL listed as 100 percent continuous duty rated.
5. Electronic trip devices
- a. Electronic trip device shall be a digital solid state type with true rms current sensing to provide protection from overloads, short circuits and ground faults. Device shall include short circuit, overload and ground fault indicators. At a minimum the following adjustable trip parameters shall be included:
 - 1) Long time pickup, adjustable from 50% to 100% of the rating plug value.
 - 2) Adjustable long time delay with inverse time characteristics.
 - 3) Switchable, adjustable short time pickup and delay with I²t.
 - 4) Adjustable instantaneous pickup
 - 5) Where required provide adjustable ground fault pickup and delay with I²t.

B. Automatic Transfer Switch

- 1. The switches shall be rated and UL listed for standby use and be open transition type, with voltage and ampere ratings including number of poles as indicated on the Drawings.
 - a. Capable of switching all classes of load, and rated for continuous duty when installed in a non-ventilated enclosure.
 - b. 6-cycle or less closing and withstand current rating: 65,000 amperes RMS minimum.
 - c. Complete with all accessories; Nameplate with Standard UL-1008 listing acceptable for use on standby systems.
 - d. Double throw, actuated by 2 electrical operators, momentarily energized and connected to a simple over-center linkage.
 - e. Minimum transfer time of 400 milliseconds. Provide adjustable transfer time delay, 1-300 seconds factory set at 3 seconds.

- f. Switches shall be capable of transferring successfully in either direction with 70 percent of rated voltage applied to the terminals.
2. The time delay between the opening of the closed contacts and the closing of the open contacts shall allow for voltage decay before transfer, allowing the motor and transformer loads to be re-energized after transfer with normal in-rush current.
3. Normal and Standby Contacts: Positively interlocked mechanically and electrically to prevent simultaneous closing.
 - a. Main contacts shall be of silver-tungsten alloy, mechanically locked in position in both the normal and standby positions without the use of hooks, latches, or magnets.
 - b. Provide separate arcing contacts with magnetic blowouts on each pole.
4. Automatic transfer switches utilizing interlocked molded case circuit breakers, switches or contactors are not acceptable.
5. Equip transfer switch with a permanently attached, safe, manual operator designed to prevent injury to personnel in the event the electrical operator becomes energized during manual transfer.
 - a. Manual operator shall provide the same contact-to-contact transfer speed as the electrical operator to prevent a flashover from slowly switching the main contacts.
 - b. Transfer switch shall have an external manual operator arranged so that the switch can be operated manually under full load without opening the enclosure door.
6. Provide test switch to simulate normal power failure, and mount pilot lights on the cabinet door to indicate switch position.
7. Provide transfer switch with a microprocessor based control panel.
8. Performance
 - a. Transfer to the standby power source shall occur when 90 percent of rated voltage and frequency has been obtained by generator.
 - b. After restoration of normal power on all phases to 90 percent of rated voltage, an adjustable time delay period of zero to 60 minutes shall delay retransfer to the normal source to allow for stabilization of normal power.
 - c. A 5 minute, nominal and adjustable, unloaded running time of the standby generator shall then take place. Should the standby power source fail during this time delay period, the switch shall automatically return to the normal source.
9. Accessories: Provide automatic transfer switch with the following features:
 - a. Time delay relays to control contact transition time on transfer to either source, pneumatic type, adjustable 1-300 seconds.
 - b. Test switch to simulate normal power failure.
 - c. Two sets of normally open contacts that close when normal source fails.
 - d. Two sets of normally closed contacts that open when normal source fails.

- e. 2 auxiliary contacts rated 15 amperes at 120 VAC on main shaft, closed on normal.
 - f. 2 auxiliary contacts rated 15 amperes at 120 VAC on main contacts, closed on standby.
 - g. Pilot lights to indicate transfer and bypass switch position.
10. Provide automatic transfer switches as manufactured by:
- a. GE Controls, Zenith Type ZTS with Microprocessor Based Control
 - b. ASCO
 - c. Approved equal.

C. Metering Transformers

- 1. All instrument transformers shall be UL listed and classified as indicated in drawings.
- 2. Current Transformers shall be as shown on drawings with burden and accuracy to support connected meters and relays as required by ANSI/IEEE C57.13.

D. Surge Protective Device (SPD)

- 1. The SPD shall be mounted integrally with the switchboard and shall be manufactured by the same manufacture as the switchboard.
- 2. The Voltage Protection Rating (VPR) shall be tested in accordance with the latest revision of UL-1449. Where an integral disconnect is provided, the VPR shall be determined with the integral disconnect included. The VPR rating shall not exceed the values of the following tables.
- 3. UL 1449 3rd Edition Voltage Protection Ratings (VPR) with integral disconnect.

SPD Voltage Rating	System Configuration	L-N	N-G	L-G	L-L
120/208-240	WYE (or) Single-Split Phase	900	900	900	1200
277/480	WYE	900	900	900	1200
347/600	WYE	1500	1500	1500	2000
240	Delta	1500	1500	1500	3000
480	Delta			1500	2000

- 4. UL 1449 3rd Edition Voltage Protection Ratings (VPR) without integral disconnect.

SPD Voltage Rating	System Configuration	L-N	N-G	L-G	L-L
120/208-240	WYE (or) Single-Split Phase	700	700	700	1200
277/480	WYE	700	700	700	1200
347/600	WYE	1200	1200	1200	2000
240	Delta	1500	1500	1500	3000
480	Delta			900	1800

5. Surge Life Rating shall be determined by the application of an 8x20us, 10kA short circuit Category C High test waveform across the SPD as defined by ANSI/IEEE C62.41.2-2002. The test wave shall be injected at one-minute intervals until the conclusion of the test or device failure. A failure is defined as either performance degradation or more than 10% deviation of clamping voltage at the specified surge current.
6. The SPD shall have maximum surge current rating based on testing of a complete SPD unit including fuses and all components that make up the SPD system using an IEEE C62.41, 8x20us current wave applied at the maximum, per mode rated value of the SPD. Devices that derive a maximum surge current rating by adding test results of individual components are not acceptable.
7. Surge Current Ratings shall be as follows for service entrance locations:
 - a. Maximum Single Impulse Surge Current Rating: 125 kA per mode.
 - b. UL 1449 Nominal Discharge Current Rating (In): 20kA
 - c. Minimum Surge Life Rating: 10,000 IEEE C62.41 C-High (C3) impulses
8. SPD shall be UL witness tested to a fault current rating equal to or greater than the fault current rating of the distribution equipment. The SPD short-circuit current (SCCR) rating shall be marked on the SPD in accordance with the requirements of UL 1449 and NEC Article 285.
9. The Maximum Continuous Operating Voltage (MCOV) for all voltage configurations shall be at least 115% of nominal on 480/277 volt systems.
10. The SPD fusing system shall be capable of allowing the rated Maximum Single Impulse Surge Current to pass without premature fuse operation. SPDs utilizing a fusing system that opens at or below the Maximum Single Impulse Surge Current rating are unacceptable.
11. SPDs shall include integral fusing for each suppression component. Designs that rely solely on an electrical panel's main breaker to interrupt fault currents resulting from a shorted suppression component are not allowed.
12. SPDs installed in switchboards shall have an integral non-fused disconnect.
13. SPDs shall be factory-mounted integral to the electrical distribution equipment and shall not violate the equipment manufacturer's UL label.
14. Provide status indicator light, form C status relay for remote monitoring, and audible alarm with enable/disable switch.

15. Provide SPD by General Electric Tranquell Series; Eaton Corporation Clipper Power System, Visor Series; Square D/Schneider Electric; or approved equal.

E. Wiring

1. Low voltage instrument and control wiring shall be copper, Type SIS, flameproof switchboard wire identified with shrink-on marker sleeves at each end. Low voltage wiring terminal blocks shall have marking strips and shall be mounted vertically in an accessible location. All terminal lugs shall be of the full loop type.

F. Door Switch

1. Heavy duty, limit switch, single pole/single throw with mechanical snap switch mechanism.
2. UL listed
3. Switch shaft sealed to ensure dust and water tight switch having enclosure rating of NEMA 13.
4. NEMA A600 switch rated 600V, 10A continuous duty; configurable for clockwise or counterclockwise configuration.
5. Snap action with silver allow contacts and screw type terminal clamps.
6. Switch and roller arm at switchboard door with one normally closed contact for monitoring intrusion to the facility PLC as shown on the Drawings.
7. Square D, Series 9007, Honeywell, or approved equal.

G. Marking and Identification

1. Nameplates shall be provided on all hinged doors for unit load description and for each control or indicating device. Nameplates shall be engraved as shown on the Drawing or as directed, using lettering approximately 3/8-in high for unit identification nameplates and 1/4-in high elsewhere. The nameplates shall be black and white laminated phenolic material. The engraving shall extend through the white exterior lamination to the black core. Nameplates shall be screw fastened.
2. A manufacturer's plaque shall be fastened to the front of the switchboard. The plaque shall indicate model number, serial number, amperes, volts, short circuit rating, etc.
3. Each switchboard shall be furnished with a sign marked "DANGER - 480 VOLTS KEEP OUT". Letters shall be not less than 1-in high, 1/4-in stroke. Signs shall be adhesive backed Mylar, OSHA approved.
4. Provide arc flash labeling per Section 16001.

PART 3 - EXECUTION

3.01 GENERAL

- A. Factory quality control.
 1. Perform manufacturers standard production testing and inspection in accordance with NEMA and ANSI standards.
- B. Power monitoring equipment shall be incorporated into the power distribution equipment as shown on the drawings and specified herein. Provide all mounting

hardware, CTs, VTs, control power transformers, and installation details including grounding requirements to ensure that the power monitoring equipment are installed in conformance with the manufacturer and the supplier of the equipment.

- C. Power monitoring equipment installation within the equipment shall not violate the manufacturer's warranty for the power monitor or the respective equipment.

3.02 INSTALLATION

- A. Switchboard floor sills shall be bolted directly to the finished floor or equipment pad. Structure shall be leveled and plumb. Anchor bolts shall be as sized per Section 01612 and 01614. Provide hardware and shims for installation.
- B. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed.
- C. All conduit entering or leaving a switchboard shall be stubbed into the bottom or top horizontal wireway directly below or above the vertical section in which the conductors are to be terminated.
- D. Install the equipment in accordance with the manufacturer's instructions.
- E. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.
- F. Make wiring interconnections between shipping splits.
- G. Install bus splice plates and torque connections.
- H. Seal all seams, cracks, or openings in outdoor enclosures.
- I. Install arc flash warning labels in conformance with Section 16001.

3.03 FIELD QUALITY CONTROL

- A. The Contractor shall make the following minimum tests and checks before the testing agency's representative is called in for testing and adjustment per the requirements of Section 16000.
 - 1. Megger incoming line terminals and buses, phase-to-phase and phase-to-ground after disconnecting devices sensitive to megger voltage.
 - 2. Remove current transformer shunts after completing secondary circuit. Check polarity and continuity of metering and relaying circuits.
 - 3. Check mechanical interlocks for proper operation.
 - 4. Test ground connections for continuity and resistance.
 - 5. Adjust unit compartment doors.
 - 6. Check control circuit interlocking and continuity with starters in the TEST position. Provide external source of control power for this test.
 - 7. Adjust voltage trip devices to their correct settings.
- B. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the Engineer and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Engineer prior to placing the equipment back into service.

- C. All as-built drawings shall be corrected and verified for correctness of in-field changes by the Contractor prior to submittal to the Engineer for final review.
- D. Where ground fault protection is included on the main service disconnect, performance testing shall be provided. Testing shall occur on the installed ground fault protection equipment at the site. Testing shall be in accordance with the manufacturer's instructions of the provided equipment. A written record of this test shall be provided to the City.

3.04 ADJUSTMENT

- A. The switchboards manufacturer shall provide the services of a factory trained service technician for start-up and training of the District's personnel. The first trip shall be coordinated with the equipment start-up. The second trip shall include any necessary follow-up or punch list work and shall also include instructions to the District. The manufacturer's service technician shall demonstrate and test all operational features of the installed equipment to the satisfaction of the Engineer. Submit a certified copy of the field inspection to the Engineer. No equipment shall be energized without the approval of the Engineer.
- B. The switchboard manufacturer's factory service technician shall make the following inspection, tests and adjustments:
 - 1. Calibrate and test main and feeder circuit breaker trip devices per the Coordination Study specified in Section 16080.
 - 2. Inspect the installation for compliance with the manufacturers recommended installation practices and report all deviations to the Engineer.

3.05 CLEANING

- A. Remove all rubbish and debris from inside and around the switchboard. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION

SECTION 16442

MOTOR CONTROL CENTER

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included:

1. Furnish, install and test the motor control centers as shown on the Drawings in accordance with these Specifications.
2. Motor control centers shall be sized to include all equipment, spares and spaces as shown on the Drawings.
3. The Contractor shall coordinate the size of the motor control center foot print with the size of the equipment pad.

B. Related sections:

1. Section 01612 – Seismic Design Criteria
2. Section 01614 – Wind Design Criteria
3. Section 13410 – Process Instrumentation and Controls, General Provisions
4. Section 13420 – Control Panels and Hardware
5. Section 16001 – Electrical - General Provisions
6. Section 16272 – Dry Type Transformers
7. Section 16230 – Standby Diesel Engine-Generator
8. Section 16448 – Panelboards

1.02 QUALITY ASSURANCE

- A. The motor control centers shall be the product of a manufacturer who shall also be the manufacturer of all the circuit breakers, fused switches, motor starters, reduced voltage solid state starters which are included in the motor control centers.
- B. Motor control centers shall be designed, assembled and tested by the manufacturer of the motor control equipment included in the control center assembly.
- C. System integrators or fabrication shops that provide custom control wiring for motor control centers shall be a UL listed and certified shop.
- D. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

1.03 SUBMITTALS

- A. Submittals shall be in accordance with Sections 01330 and 16001.
- B. The Contractor shall furnish submittals for approval as outlined below:
 1. Motor Control Centers
 - a. Equipment outline drawings showing elevation and plan views, dimensions, weight, shipping splits, conduit entrance and metering layouts. Indicate all options, special features, ratings and deviations from the Specifications.

- b. Unit summary tables showing detailed equipment description and nameplate data for each compartment.
 - c. Product data sheets and catalog numbers for all integral components such as overcurrent protective devices, motor starters, variable frequency drives, control relays, control stations, meters, pilot lights, etc. List all options, trip adjustments and accessories furnished specifically for this Project.
 - d. Submit memory maps of data available from electronic motor starters, and power meters over the Modbus TCP interface. Submit details on configuration of devices for future access to this data. However, delivering data from these devices to the control components specified in Section 13410 is not required under this Contract.
 - e. Provide single line diagram and interconnection diagrams showing wire and terminal identification numbers.
 - f. Operations and maintenance manual
 - 1) Instruction and renewal parts books.
 - 2) Itemized list of spare parts furnished specifically for this Project, including quantities, description and part numbers.
 - 3) Protective device time-current characteristics.
- C. Submit cooling calculations for the motor control center weatherproof enclosure indicating conformance with cooling requirements of the supplied equipment under the indicated ambient environmental conditions. Calculations shall include the recommended type of equipment required for cooling that will ensure maintaining the integrity of the NEMA MCC rating. State all assumptions including ambient temperature, equipment and bussing heat release, skin convectivity, and other variables necessary to determine the requirements of the cooling equipment to maintain internal temperature within the maximum operating temperatures of all MCC devices and control panel equipment as specified in Section 13410.
- D. Submit preliminary harmonic calculations indicating conformance with the harmonic limitations as specified herein.
- 1. Provide calculations under both utility and standby generator power sources.
 - 2. Contractor shall be responsible for obtaining all required input data necessary from the utility and equipment suppliers necessary to perform the study.
 - 3. The specific harmonic spectrum from the proposed equipment shall be used to produce for the calculations. Calculation based on generic spectra for an "ideal" harmonic source shall not be acceptable.
 - 4. Submit a comprehensive harmonic analysis report indicating compliance for total and for individual harmonic frequencies from 0 to the 50th harmonic for both voltage and current. Report shall be in sufficient detail and with documented assumptions to confirm that the specified harmonic criteria is met for the installation.
- E. Submit anchorage calculations per the requirements of Section 01612 and 01614.
- F. Submit seismic certification and equipment anchorage details as specified.
- 1.04 DELIVERY, STORAGE AND HANDLING
- A. Refer to Section 16001.

1.05 REFERENCE STANDARDS

- A. Motor control centers shall be designed, built and tested in accordance with the latest editions and revisions of NEMA Standard ICS-2 and Underwriters' Laboratories Standard No. UL-845. Equipment shall conform to ANSI C19.3 test standards and the requirements of the National Electric Code.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- C. Institute of Electrical and Electronic Engineers (IEEE) Recommended Practice 519 (2014) - "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems."
- D. National Electrical Manufacturers Association (NEMA):
 - 1. NEMA ICS 18 – Motor Control Centers
- E. Underwriters Laboratories (UL).
 - 1. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
 - 2. UL 508 – Industrial Control Equipment
 - 3. UL 845 – Motor Control Centers
 - 4. UL 1499 – Transient Voltage Surge Suppressors

1.06 JOB CONDITIONS

- A. Unless otherwise specified, the power electronic system shall comply with the emissions and immunity limits as defined in IEC 61800-3.

1.07 UNIT RESPONSIBILITY

- A. Where a pump or package process system supplier is responsible for supplying the pump, motor and VFD as required in Division 11 or Division 13, the supplier shall coordinate the VFD and motor and provide certification that the driven equipment, motor, and VFD are compatible and will meet the system requirements of the application. Certification from the supplier shall state that they have reviewed application requirements and that the equipment, motor, and VFD combination will satisfy the application duties required, incorporating any deviations from the nominal horsepowers shown on the Contract Documents.

1.08 SPARE PARTS

- A. Spare parts shall be boxed or packaged for long term storage.
- B. Identify each item with manufacturers name, description and part number on the exterior of the package.
- C. Provide the following spare parts in the quantities specified for motor control centers:
 - 1. One dozen each size of cover bolts, cage nuts and door fasteners.
 - 2. Two cans of aerosol touch-up paint.
 - 3. 50 percent replacement fuses, all types and sizes.
 - 4. Two of each color replacement lens caps for LED pilot lights
 - 5. One motor starter electronic overload or control module of each type provided

1.09 MANUFACTURER'S FIELD SERVICES

- A. General: Manufacturer's representative shall be present at the site for a minimum of 16 hours for assistance, startup, testing, training, and certification. Travel time not included.
- B. Installation: Submit a manufacturer's certificate of proper installation upon successful completion of the field testing and startup effort.
- C. Testing: The manufacturer's service technician shall provide calibration, inspection and adjustments.
- D. Training: provide one, four hour training session for staff. Training shall review each major motor control center device including automatic transfer switch, motor starters, variable frequency drives, metering, and other equipment as required. Training shall include normal operation and troubleshooting using available equipment specific diagnostics.

PART 2 - PRODUCTS

2.01 MOTOR CONTROL CENTERS

- A. Ratings.
 - 1. Service type and voltage ratings shall be as shown on the Drawings.
 - 2. The overall short circuit withstand and interrupt rating of the equipment and devices shall be as shown on the Drawings. Main and feeder circuit protective devices shall be fully rated for the specified short circuit duty. Systems employing series connected ratings for main and feeder devices shall not be used. Motor starter units shall be tested and UL labeled for the specified short circuit duty in combination with the motor branch circuit protective device.
 - 3. The continuous current rating of the main horizontal bus shall be as shown on the Drawings. Vertical busses shall be sized for the structure and electrical loads installed in the section, and shall have a minimum rating of 300 amperes. Bus bracing shall equal or exceed the specified equipment short circuit rating.
 - 4. Motor control centers, including devices, shall be designed for continuous operation at rated current in a 40 degree C ambient temperature.
- B. Construction
 - 1. The overall NEMA 3R enclosure shall consist of a NEMA 1 gasketed enclosure MCC on a special base with an outdoor NEMA 3R house erected around the enclosure.
 - a. The outer enclosure shall be constructed from 304 stainless steel, 12 gauge minimum or as required for conformance with structural design criteria. The outer enclosure shall be fully weatherproof, padlockable, and feature a 3-point latching system. The outdoor house enclosure shall be non-walk-in with suitably dimensioned access doors for each MCC column. Exterior access door shall allow full unimpeded access to the MCC interior access covers and internal components. Provide mounting system such that the outer enclosure can be installed or removed with the interior MCC in place.
 - 2. Provide thermostatically controlled condensation space heaters within each MCC compartment.

3. Each MCC compartment shall have a single tube, 120V fluorescent light, minimum 20 Watts, mounted internally on the enclosure ceiling to provide illumination to the MCC interior. Each compartment light fixture shall be actuated by an exterior door switch with a manual switch integrated onto the fixture base. MCC enclosure light fixture shall be as manufactured by Hoffman or equal.
4. Motor control centers shall consist of a series of metal enclosed, free-standing, dead front vertical sections bolted together to form double wall construction between sections. Individual vertical sections shall be nominally 90-in high, 20-in wide and 20-in deep unless otherwise shown on the Drawings. Bottom channel sills shall be mounted front and rear of the vertical sections extending the full width of each shipping split. Top of each section shall have removable plates with lifting angle. Make provisions for field installation of additional sections to each end and provide full depth cover plates (rodent barriers) at each end of the motor control center channel sills.
5. Provide continuous top and bottom horizontal wireways extending the full width of the line-up, isolated from the horizontal bus. Provide a 9-in high horizontal wireway at the top and at the bottom in each section. Provide a 4-in wide, full height, vertical wireway in each section, equipped with a hinged door and cable supports. Vertical wireway shall be isolated from the bus and device compartments. Wireways openings shall have rolled edges or protective grommets.
6. Provide individual, flange formed, pan type door with concealed hinges and quarter turn latches for each device compartment and future space. Doors shall be removable. Door removal shall not be required to withdraw starter units or feeder tap devices.
7. Motor control centers shall be designed for standalone mounting. All wiring, bus joints and other mechanical parts requiring tightening or other maintenance shall be accessible from the front or top.
8. Enclosures mounted on a raised concrete housekeeping or equipment pad shall include operator extension handles for the upper operator controls to comply with the NEC "Two Meter" rule.

C. Unit Compartments

1. Provide individual compartments for each removable combination starter and feeder tap device unit. Each vertical section shall accommodate a maximum of six compartments. Steel barriers shall isolate the top, bottom and sides of each compartment from adjacent units and wireways. Removable units shall connect to the vertical bus in each section with tin plated, self aligning, pressure type copper plug connectors. Size 5 and larger starter units may be wired directly to the bus. Removable units shall be aligned in the structure on guide rails or shelves and secured with a cam latch mechanism or racking screw.
2. Provide individual, isolated compartments for fixed mounted devices such as circuit breakers, cable lugs, metering, relaying and control devices. Main and bus tie circuit breakers shall be wired directly to the main horizontal bus. All bus connections shall be fully rated.
3. Provide the following features:

- a. Provision to padlock removable units in a partially withdrawn TEST position, with the bus stabs disengaged.
- b. Provision to padlock unit disconnect handles in the OFF position with up to three padlocks.
- c. Mechanical interlock with bypass to prevent opening unit door with disconnect in the ON position, or moving disconnect to the ON position while the unit door is open.
- d. Mechanical split-type terminal blocks for disconnecting external control wiring.
- e. Auxiliary contact on unit disconnect to isolate control power when fed from an external source.
- f. Disconnect operating handles and control devices mounted on the removable doors or device panels.
- g. Compartments containing motor starters shall have wiring diagrams and heater tables fastened to the compartment door. Compartments containing panelboards shall have circuit directories fastened to the compartment door.

D. Bus Systems

- 1. Main horizontal bus: Silver plated copper, bolted joints, accessible from the front of the structure, fully rated throughout the lineup. Rating of the horizontal bus shall be per the rating of the MCC.
- 2. Vertical section bus: Tin plated copper, full height, totally insulated and isolated by glass polyester barriers with shutters to cover stab openings when units are withdrawn. Provide fishtape barriers to isolate bottom wireways from lower ends of vertical bus. Vertical bus rating shall be 300A.
- 3. Vertical buses used for a tie circuit breaker or tie feeder lugs shall be rated for a continuous capacity equivalent to the main horizontal bus rating.
- 4. Horizontal ground bus: Provide a tin plated copper ground bus in each section equipped with lugs for termination of feeder and branch circuit ground conductors. Connect to ground bus in adjacent sections with splice plates where shipping splits are present. Minimum ground bus rating shall be 300A.

E. Wiring

- 1. Wiring: Stranded copper, minimum size No. 14 AWG, with 600 volt, 90 degree C, flame retardant, Type MTW thermoplastic insulation, NEMA Class II, Type B. Line side power wiring shall be sized for the full rating or frame size of the connected device.
- 2. Identification: Numbered sleeve type wire markers at each termination point, color coding per NEMA Standards and the NEC. Foreign voltage control wiring shall be yellow.

F. Signage

- 1. Each motor control center shall be furnished with a sign marked "DANGER - 480 VOLTS - KEEP OUT". Letters shall not be less than 1-in high, 1/4-in stroke. Signs shall be laminated plastic, engraved white letters with a red background.

2. Compartments with voltages from sources outside of the compartment shall have a sign mounted inside the compartment door marked "CAUTION - THIS UNIT CONTAINS A VOLTAGE FROM AN EXTERNAL SOURCE". Letters shall be white on a high visibility red background.
3. Provide arc flash labeling per the Section 16001.

G. Surface Preparation and Shop Coatings

1. All non-current carrying metal parts of the control center assembly shall be cleaned of all weld spatter and other foreign material and given a heat cured, phosphatized chemical pre-treatment to inhibit rust.
2. Indoor equipment shall be finish painted with one coat of manufacturers standard electrocoated, heat cured enamel.
3. Outdoor equipment shall be finish painted with two coats of polyurethane or epoxy enamel, 2 to 3 mil thickness. Exterior color shall be ANSI 61 light grey.
4. Unpainted non-current carrying parts shall receive a protective zinc plating to prevent corrosion.

H. Manufacturers:

1. Eaton/Cutler-Hammer "Freedom 2100".
2. General Electrical "Evolution Series E9000"
3. Square D/Schneider Electric "Model 6"
4. Allen-Bradley "Centerline 2100"
5. Approved equal

2.02 COMPONENTS

A. General

1. The Drawings indicate the approximate horsepower and intended control scheme of the motor driven equipment. Provide the NEMA size starter, circuit breaker trip ratings, and control power transformers ratings matched to the motors and control equipment actually supplied, in compliance with the National Electrical Code. All variations necessary to accommodate the motors and controls as actually furnished shall be made without extra cost to the City.

B. Feeder Circuit Breakers

1. Feeder circuit breakers with a trip rating greater than 150A shall be molded case, group mounted, 3 Pole, 600 Volt, 80 percent equipment rated, plug-in type with electronic trip device.
 - a. Electronic trip device shall be a digital solid state type with true rms current sensing to provide protection from overloads, short circuits and ground faults. Device shall include short circuit, overload and ground fault indicators. At a minimum the following adjustable trip parameters shall be included:
 - 1) Long time pickup, adjustable from 50% to 100% of the rating plug value.
 - 2) Long time delay with inverse time characteristics.
 - 3) Short time pickup and delay with I²t.

- 4) Adjustable instantaneous pickup
 - b. Electronic trip device shall be General Electrical MicroEntelliGuard, Eaton Corporation/Cutler Hammer Digitrip 310 or Equal.
 2. Feeder circuit breakers less than or equal to 150A rating shall be molded case, group mounted, 3 Pole, 600Volt, plug-in type with fixed thermal magnetic type breaker.
 3. Feeder circuit breaker shall meet UL489 listing requirements.
 4. Trip unit and frame rating shall be as shown on the Drawings.
 5. Acceptable Manufactures:
 - a. Eaton Cutler Hammer, Series C
 - b. General Electric, Spectra RMS
 - c. Square D/Schneider Electric
 - d. Approved equal.
- C. Digital Multimeter (DMM)
1. Provide monitor with multiple configurable digital readouts. Meter shall be capable of monitoring and displaying individual phase voltage, individual phase current, kilowatts, kilovars, kilovars reactive, power factor, or energy as selected by the user. Accuracy shall be at least ± 0.25 % of full scale for voltage and current; ± 0.50 % of full scale for power and energy.
 2. Provide user configurable 4-20 mA analog output and three user configurable discrete alarm output contacts. User configuration shall allow selection of desired variables and alarm trip point.
 3. Provide fuse protected potential transformer and current transformers rated as required the feeder circuit monitored. Provide fuse protected 120V control power transformer for source power for the meter derived from the 480V or 240V feeder circuits.
 4. Provide Modbus TCP protocol and Ethernet communication port.
 5. Acceptable Manufactures:
 - a. Eaton Cutler Hammer, IQ Series
 - b. General Electric, Power Leader EPM
 - c. Square D/Schneider Electric
 - d. Allen-Bradley
 - e. Approved equal.
- D. Reduced Voltage Solid-State Starter (RVSS)
1. General: Provide reduced-voltage solid state motor starter housed in the Motor Control Center Structure complete with enclosure thermostatically controlled space heater and ventilation fan. RVSS components shall be tested in accordance with UL 508. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing.

2. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV. Units using triacs or SCR/diode combinations shall not be acceptable. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits.
3. Starter shall be rated for operation between -10 to 50 degrees C ambient and suitable at altitudes up to 3300 feet without deration. Provide conformally coated logic boards for addressing site specific environmental concerns.
4. Provide paralleling run bypass contactor that energizes when the motor reaches 90% of full speed and close/open under rated full load motor current. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions.
5. Digital interface module mounted on the face of the unit shall be used to program the soft starter. Display shall include six line LED readout. Monitoring parameters shall include line currents, pole currents, pole voltages, number of starts, and DC control voltage. Soft starter shall display motor status and the previous 5 fault conditions.
6. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via digital interface module. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting or the device keypad. Units using bimetal overload relays are not acceptable.
7. Starter shall be capable of either an electronic or mechanical reset after a fault.
8. Overtemperature protection (on heat sink) shall be standard.
9. Starters shall provide protection against:
 - a. Improper line-side phase rotation as standard executing and orderly shutdown if a line-side phase rotation other than A-B-C exists.
 - b. Phase loss or unbalance condition, shutting down if a 50% current differential between any two phases is encountered.
 - c. Motor stall condition
 - d. Motor jam condition
 - e. Protection features shall be able to be enabled or disabled via the RVSS digital interface module.
10. Reduced voltage starter shall be provided with UL listed, heavy duty industrial type power factor correction capacitors mounted as part of the motor control center lineup either in dedicated MCC buckets or in a separate enclosure mounted above the associated MCC section as required by the manufacturer.
 - a. Power factor correction capacitors shall be as recommended, selected, and furnished by the motor control center manufacturer to raise the motor power factor to approximately 95 percent.

- b. Capacitors shall be dry film or liquid insulated and shall be hermetically sealed in steel enclosures.
 - c. Each capacitor unit shall be furnished with three high interrupting capacity current limiting fuses. Fuses shall be equipped with "blown-fuse" indicators.
 - d. Provide dedicated switching contactors for the capacitor banks integrated with the RVSS starting logic to switch the capacitors into the motor circuit upon completion of the RVSS startup ramping with motor receiving full voltage and at full speed.
11. Provide the following control function adjustments from digital interface module:
- a. Selectable Torque Ramp Start or Current Limit Start
 - b. Adjustable Kick Start Time: 0–2 seconds
 - c. Adjustable Kick Start Torque: 0–85%
 - d. Adjustable Ramp Start Time: 0.5–180 seconds
 - e. Adjustable Initial Starting Ramp Torque: 0–85%
 - f. Adjustable Smooth Stop Ramp Time: 0–60 seconds
12. Provide linear pump ramp logic option to allow linear ramping of centrifugal pump load based on ramping parameters entered from the RVSS keypad.
13. Maximum continuous operation shall be at 115% of continuous ampere rating
14. Starter shall be provided with the following Form C digital output contacts:
- a. Run
 - b. Fault
 - c. High Temp
 - d. In Bypass
 - e. Ready
15. Unit shall have [DeviceNet][Modbus][Profibus] [Ethernet] communication option.
16. Acceptable manufactures:
- a. Eaton/Cutler Hammer "S811"
 - b. General Electric (ABB) "ASTAT IBP"
 - c. Approved equal.
- E. Relays and Timers
- 1. Control relays and timers: 300 volt, industrial rated, plug-in socket type, housed in a transparent polycarbonate dust cover, designed in accordance with UL Standard 508 for motor controller duty. Continuous contact rating shall be 10 amperes resistive, 1/4 HP, at 120 VAC, operating temperature minus 10 to plus 55 degrees C. Relays and timers shall be Potter & Brumfield KRP Series or approved equal with neon coil indicator light and calibrated timing knob or DIP settable controls.
- F. Distribution Transformer: provide as specified in Section 16272 within the motor control center enclosure as shown on the Drawings.

- G. Lighting Panelboard: provide as specified in Section 16448 within the motor control center enclosure as shown on the Drawings.
- H. Miscellaneous Units
 - 1. Elapsed time hour meters: Five digit, non-reset type, with 120 volt synchronous motor.
 - 2. Door Switch:
 - a. Heavy duty, limit switch, single pole double throw, double break with mechanical snap mechanism.
 - b. UL listed
 - c. Switch shaft sealed to ensure dust and water tight switch having enclosure rating of NEMA 13.
 - d. NEMA A600 switch rated 600V, 10A continuous duty; configurable for clockwise or counterclockwise configuration.
 - e. Snap action with silver allow contacts and screw type terminal clamps.
 - f. Double pole switch and roller arm at each enclosure door with one normally open contact used to operate the enclosure light fixture and the normally closed contact for monitoring MCC intrusion, wired in series with other normally closed door switch contacts to the facility PLC as shown on the Drawings.
 - g. Square D, Series 9007, Honeywell, or approved equal.
- I. Control Panel Section: Provide an unbussed motor control center section integrated into the motor control center lineup for the control panel specified in Section 13420. Coordinate final dimensions and provide mounting hardware, 120VAC power sources, and other auxiliary terminal blocks and components with the requirements of Section 13410 and Section 13420.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Motor control center floor sills shall be bolted directly to the finished floor or equipment pad per submittal approved anchorage calculations. Structure shall be leveled and plumb. Anchor bolts shall be as sized per Section 01612 and 01614. Provide hardware and shims for installation.
- B. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps. Circuit groups shall be supported so that circuit terminations are not stressed.
- C. In general, all conduit entering or leaving a motor control center shall be stubbed into the bottom horizontal wireway directly below or above the vertical section in which the conductors are to be terminated.
- D. Housekeeping pads shall be included for the motor control centers as detailed on the Drawings.
- E. Install the equipment in accordance with the manufacturer's instructions.
- F. Remove temporary lifting angles, lugs and shipping braces. Touch-up damaged paint finishes.

- G. Make wiring interconnections between shipping splits.
- H. Install bus splice plates and torque connections.
- I. Seal all seams, cracks, or openings in outdoor enclosures.

3.02 FACTORY QUALITY CONTROL

- A. The motor control center shall be tested per the manufactures standard factory tests.

3.03 FIELD QUALITY CONTROL

- A. The Contractor shall make provisions for acceptance testing per the requirements of Section 16001.
- B. In the event of an equipment fault, notify the Engineer immediately. After the cause of the fault has been identified and corrected, a joint inspection of the equipment shall be conducted by the Contractor, the Engineer and the equipment manufacturer's factory service technician. Repair or replace the equipment as directed by the Engineer prior to placing the equipment back into service.
- C. Provide field harmonic analysis after startup monitoring power harmonics while the treatment facility is in full operation. Monitor harmonics using a suitable harmonic analyzer over a 2 hour period of full operation. Submit a final report summarizing total harmonic distortion and individual frequency distortion up to the 50th harmonic for both voltage and current. Report shall verify that the specified harmonic criteria specified herein are met by the final installed system.
- D. All as-built drawings shall be corrected and verified for correctness of in-field changes by the Contractor prior to submittal to the Engineer for final review.

3.04 CLEANING

- A. Remove all rubbish and debris from inside and around the control center. Remove dirt, dust, or concrete spatter from the interior and exterior of the equipment using brushes, vacuum cleaner, or clean, lint-free rags. Do not use compressed air.

END OF SECTION

SECTION 16448

PANELBOARDS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Work included.
 - 1. Furnish all labor, materials, equipment and incidentals required and install all lighting panelboards as shown on the Drawings and as specified herein.
 - 2. Lighting panelboards shall be mounted within the motor control center as specified under Section 16442.

1.02 RELATED SECTIONS

- A. Section 16001 – Electrical - General Provisions
- B. Section 16442 – Motor Control Centers
- C. Related work:
 - 1. Panelboard schedules are shown on the Drawings.

1.03 SUBMITTALS

- A. Submit shop drawings and product data in accordance with Section 01300 and 16442.
- B. The Contractor shall furnish submittals for approval as outlined below:
 - 1. Submit catalog cuts and descriptive literature for each type of panelboard and breaker provided.
 - 2. Submit panelboard directory for each panelboard showing circuit allocations, breaker rating, poles, spare, short circuit, and continuous bus ratings.

1.04 REFERENCE STANDARDS

- A. American National Standard Institute (ANSI)
 - 1. ANSI Z55.1 – Gray Finishes for Industrial Apparatus and Equipment
- B. National Electrical Manufacturers Association (NEMA):
 - 1. PB-1 – Panelboards
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70 – National Electrical Code (NEC).
- D. Underwriters Laboratories (UL).
 - 1. UL 50 – UL Standard for Enclosures for Electrical Equipment
 - 2. UL 67 – UL Standard for Panelboards
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Panelboards shall be fully rated for the specified circuit breaker fault current interrupting capacity. Series connected short circuit ratings are not acceptable.
- B. Provide panelboard within the motor control center specified under Section 16442.
- C. Construction
 - 1. Panelboard construction shall be per the requirements of UL 50 and UL 67.
 - 2. Provide panelboards with factory assembled interiors complete with bussing, circuit breakers, wire connectors, etc. All wire connectors, except screw terminals, shall be of the anti-turn solderless type, suitable for copper or aluminum wire of the sizes indicated on the Drawings.
 - 3. Provide interiors designed so that circuit breakers can be replaced without disturbing adjacent units and without removing the main bus connectors. Circuiting changes shall be field executed without machining, drilling or tapping.
 - 4. Branch circuits shall be arranged using double row construction except when column-type construction is indicated. Branch circuits shall be numbered by the manufacturer.
 - 5. Provide manufacturer's nameplate listing manufacturer's name, panel type, and ratings. A second identification nameplate shall be provided on the front of each panelboard with the panelboard designation shown on the Drawings. Designation nameplates shall be as specified in Section 16001.
 - 6. Hinged doors covering all circuit breaker handles shall be included in all panel trims.
 - 7. Provide directory frame and card having a transparent cover on the door interior.
 - 8. All exterior and interior steel surfaces of the panelboard shall be properly cleaned and finished with ANSI Z55.1, No. 61 light gray paint over a rust-inhibiting phosphatized coating. The finish paint shall be of a type to which field applied paint will adhere.
- D. Buses
 - 1. Provide copper phase and neutral bus bars. Provide full-height/full-rating phase and neutral bussing without tapering or reduction. Cross connectors shall be copper.
 - 2. Neutral bussing shall have a suitable lug for each outgoing feeder requiring a neutral connection. Provide 100% rated neutral bus where shown on the Drawings.
 - 3. Spaces for future circuit breakers shall be bussed for the maximum number devices for the panelboard as shown on the Drawings.
 - 4. Provide copper panelboard ground bus.

2.02 LIGHTING AND AUXILIARY LOAD PANELBOARDS

- A. Application: Provide lighting and auxiliary load panelboards (generally referred to as Lighting Panels on the Contract Documents) for serving lighting, receptacles, and ancillary project loads operating at less than 250V to ground, single or three-phase.

B. Ratings:

1. Voltage rating: 208Y/120V, 3 phase, 4 wire
2. Continuous bus current rating: as shown on the Drawings
3. Minimum short circuit current rating: 10 kA Symmetrical

C. Circuit Breakers

1. Lighting panelboards shall be equipped with circuit breakers with frame size, number of poles, and trip settings as shown on the Drawings.
2. Circuit breakers shall be as manufactured by the lighting panelboard manufacturer.
3. Two and three-pole circuit breakers shall be constructed as a single unit with common handle. The use of single pole breakers with handle-ties, special brackets, other "ganging" means are not acceptable.
4. Lighting panel main and feeder circuit breakers shall be thermal-magnetic type. Provide bolt-on, heavy-duty breakers with toggle handles or other means to visually indicate when the unit has tripped. Provide circuit breaker interrupting rating matching or exceeding the required rating of the panelboard where installed.
5. GFCI (ground fault circuit interrupter) shall be provided for circuits where shown on the Drawings. GFCI units shall be 1 pole, 120 Volt, or 2 pole, 240 Volt as shown on the Drawings. Provide molded case, bolt-on breakers, incorporating a solid state ground fault interrupter circuit insulated and isolated from the breaker mechanism. The unit shall be UL listed Class A Group I device (5 milliamp sensitivity, 25 millisecond trip time) and a minimum interrupting capacity of 10,000 amperes RMS. GFCI units used for heat tracing or where required by the served equipment manufacturer shall have 30 mA sensitivity.
6. Provide circuit breaker handle locks for circuits serving critical supervised loads where shown on the Drawings.

D. Acceptable Manufactures:

1. General Electric, A-Series Panelboard
2. Eaton Corporation/Cutler-Hammer, Pow-R-Line Series Panelboard
3. Square D
4. Approved equal

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Refer to Section 16442.
- B. Install panelboards in accordance with manufacturer's recommendations. Connect main and branch feeder circuits on proper terminals. Minimize excess wire within the panelboard enclosure to decrease excess heat generation. Arrange cables in wiring gutter and lace together with twine or tie wraps to minimize chance of catching wire insulation on panel hardware.

- C. Connect panelboard branch circuit loads so that the load is balanced and distributed as equally as possible between the phase busses based on the actual installed equipment characteristics.
- D. Before energizing, verify and tighten all connectors, lugs, and mounting screws. Vacuum out all extraneous scraps of wire, plaster, dust, and other foreign material from inside the panelboard. Install dead-front shield.
- E. Complete circuit directory cards giving clear, evident, and specific nature of each load served. Description shall have sufficient detail to uniquely distinguish each circuit from all others. Completed circuit directory cards shall be type written. Install circuit directories in each panelboard.
- F. Install markers on the front cover of all panelboards which identify the voltage, current, and phases. Markers shall be made of self sticking B-500 vinyl cloth printed with black characters on an Alert Orange background, 2-1/4-in high by 9-in wide, Style A as manufactured by W.H. Brady Co. or approved equal.
- G. Install panelboard nameplates as shown on the Drawings and as specified in Section 16001.
- H. Install manufacturer's standard arc flash warning labels in conformance with Section 16001.
- I. Perform final cleanup of panel interior with vacuum. Compressed air shall not be used.

3.02 FIELD QUALITY CONTROL

- A. Acceptance testing of the panelboard shall be per the requirements of Section 16442 and 16001.
- B. Periodically inspect panelboard during startup while under load. Verify temperature of panelboard cover surface. If surface is excessively hot, de-energize panelboard and notify the Engineer.

END OF SECTION

SECTION 16500
LIGHTING SYSTEM

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install a complete lighting system ready for operation as shown on the Drawings and as specified herein.

1.02 RELATED WORK

- A. Section 16001 – Electrical - General Provisions.
- B. Lighting fixture descriptions are included under Appendix 16500-A.

1.03 SUBMITTALS

- A. Submittals shall include those set forth in Section 16001 and shall be in accordance with Section 01340.
- B. The submittals shall contain the following product information as a minimum:
 - 1. Fixtures: Manufacturer, model number, materials of construction, finish type and color, total fixture wattage (ballast plus lamp), mounting hardware and optional control or operational features.
 - 2. Ballasts: Manufacturer, model number, total harmonic distortion, crest factor, external wiring diagram, power factor.
 - 3. Drivers: operational and control features, total harmonic distortion, power factor
 - 4. Lamps: Manufacturer, model number, wattage, color rendition index, lumen output.
 - 5. Fixture photometric data in ANSI/IESNA LM-63-02 standard format.
- C. All Light Emitting Diode (LED), fluorescent fixtures (except compact fluorescent), and ballasts shall be provided with certification from the manufacturer that they are bear the Environmental Protection Agency “Energy Star” certification.
- D. LED fixture submittals shall include manufacturer’s standard DOE LED Lighting Facts label.

1.04 REFERENCE STANDARDS

- A. Department of Energy DOE, Lighting Facts program
- B. DesignLights Consortium
 - 1. Product Qualifications Criteria
 - 2. Qualified Products List
- C. Environmental Protection Agency (EPA), Energy Star Publications
- D. National Fire Protection Association (NFPA) 70, National Electrical Code
- E. National Energy Policy Act of 2005

- F. Underwriters Laboratories (UL)
 - 1. UL 508A – Industrial Control Panels
 - 2. UL 916 - Standards for Energy Management Equipment
 - 3. UL 924 – Emergency Lighting and Exit Signs
 - 4. UL 935 – Fluorescent-Lamp Ballasts
 - 5. UL 8750 – Light Emitting Diode (LED) Equipment for Use in Lighting Products
- 1.05 QUALITY ASSURANCE
 - A. Manufacturer Qualifications:
 - 1. Company with not less than ten years of experience manufacturing luminaires, dimming ballasts, dimming drivers, and lighting control systems.
 - 2. ISO 9001 certification, including in-house engineering for product design activities.
 - 3. Manufacturing facility employing electrostatic discharge reduction practices in compliance with ANSI/ESD S20.20 or equivalent.
- 1.06 DELIVERY, STORAGE, AND PROTECTION
 - A. Receive, handle, and store products according to NECA/IESNA 500 and manufacturer's written instructions.
 - B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- 1.07 SPARE PARTS AND MAINTENANCE
 - A. All spares shall be delivered in manufacturer's packaging suitable for protection from damage during long-term storage.
 - B. Lenses and Louvers: 5 percent of total quantity but not less than one of each type provided.
 - C. Extra Lamps: 10 percent of total quantity but not less than one of each type provided.
 - D. Extra Ballasts or External Drivers: 5 percent of total quantity but not less than one of each type provided.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All lighting fixtures shall be in accordance with the National Electrical Code (NEC) and shall be constructed in accordance with the latest edition of the applicable Underwriters Laboratories "Standards for Safety, Electric Lighting Fixtures." All lighting fixtures shall be Underwriters Laboratories labeled.
- B. Ballasts and lamps shall comply with the requirements of the "National Energy Policy Act of 2005."
- C. Ballasts, drivers, lamps, and controls shall comply with applicable portions of the California Energy Codes.
- D. All lighting control panels shall utilize UL listed components and shall be manufactured and assembled in accordance with UL Standard 508.

2.02 MATERIALS

A. Lighting Fixtures

1. Lighting fixture types shall be furnished as required by the "Lighting Fixture Schedule" on the Drawings. The catalog numbers are given as a guide to the design and quality of fixture desired. Equivalent designs proven with reviewed and approved calculations and equal quality fixtures of other manufacturers will be acceptable upon approval by the Construction Manager.
2. All LED fixtures and luminaires shall be listed on the DesignLights Consortium, Qualified Products List.
3. Where fixtures are to be installed recessed, verify the type of ceiling or wall construction and provide the appropriate frames, mounting devices, and hardware.

B. Lamps

1. Light Emitting Diode (LED) Lamps
 - a. Initial LED lumen output – 100% rated lumen output as specified on the Drawings
 - b. Light Output Depreciation Category – Category 1, Initial at 90%, 25% rated life
 - c. Failure Fraction – F10 (10%)
 - d. Color temperature:

Correlated Color Temperature	
Nominal CCT (K)	Allowable Tolerance (K)
2700	2725±145
3000	3045±175
3500	3465±245
4000	3985±275
4500	4503±243
5000	5028±283
5700	5665±355
6500	6530±510

- e. Minimum color rendering index value – 80
- f. Maximum color rendering index value shift – 10%
- g. Power factor: 85% minimum
- h. Outdoor fixture ambient operating temperature rating / range: 15°C to 40°C
- i. LED Lamps shall be manufacturers by Cree, Samsung, Nichia Corporation, LumaLED, or equal.

2. Fluorescent Lamps
 - a. Lamps shall meet applicable sections of ANSI C82 and C78 standards.
 - b. Lamps shall be 4100 Kelvin corrected color temperature.
 - c. Unless specifically noted otherwise on the fixture schedule, all lamps shall be 265 mA, T8, instant start, and medium bi-pin. Length and wattage shall be per the fixture schedule.
 - d. All fluorescent lamps shall be of one manufacturer and shall be as manufactured by Osram-Sylvania Electric Products, Inc.; General Electric Co.; North American Philips Lighting Corp. or approved equal.

C. LED Fixture Drivers

1. Provide constant-current or constant-voltage drivers compatible with the selected fixture rated for operations for a minimum of 50,000 hours at maximum case temperature and 90 percent non-condensing relative humidity.
2. Provide thermal protection with automatic power output reduction to protect LED driver and LED light engine/fixture from damage due to over-temperature conditions. Reduction shall be applied when temperatures approach or exceed the LED driver's maximum operating temperature at calibration point.
3. Protective Features
 - a. Designed and tested to withstand electrostatic discharges without impairment when tested according to IEC 61000-4-2 or equivalent.
 - b. Designed and tested to withstand Category A surges of 4,000 V according to IEEE C62.41.2 without impairment of performance.
 - c. Meet NEMA 410 inrush requirements for mitigating inrush currents with solid-state lighting sources.
 - d. Employ integral fault protection and overvoltage protection up to 277 V for constant-voltage type; provide short-circuit, open-circuit, and overload protection for constant-current type.
4. UL Type TL rated or UL Class P listed where specified. Suitable for field replacement as applicable; listed in accordance with UL 1598C or UL 8750; Class P where specified.
5. Class A Sound Rating: Inaudible in a 27 decibels (dBA) maximum ambient.
6. No visible change in light output under a variation of plus or minus 10 percent change in line-voltage input.
7. Provide LED drivers designed to evenly track across multiple fixtures of the same family or series at all light levels. UL Class 2 output suitable for hot swap of LED lamps.
8. 3-Wire Control: Provide integral control circuitry where specified. Control operation shall be from input voltage of 120 V through 277 V at 50/60 Hz.
9. Dimming type where specified in the Lighting Fixtures descriptions. Provide dimming range 100 to 1 percent measured output current unless otherwise specified. Provide pulse width modulation (PWM) output dimming frequency meeting IEEE 1789 requirements or constant-current reduction method.

10. Paired with LEDs and rated at least 20 percent greater than the maximum wattage rating of the driven fixture.
11. Meet requirements for solid-state devices for power factor, transient protection, power consumption, start time, and operating frequency per Energy Star Luminaires. Total harmonic distortion less than 20 percent at maximum power.

D. Ballasts

1. Unless otherwise indicated in the Lighting Fixture Schedule, fluorescent ballasts shall be electronic, 25 kHz or higher, full-output, rapid-start type for use on 265 mA, T8 lamps.
 - a. All ballasts shall be U.L. listed, ETL certified, Class "P", high power factor.
 - b. Ballasts shall have an "A" sound rating or better.
 - c. All ballasts used in exterior applications shall have a minimum starting temperature of 0 degrees F unless otherwise specified.
 - d. All interior ballasts shall have a minimum starting temperature of 50 degrees F.
 - e. Ballasts shall be series wired type and designed to operate the number and length of lamps specified.
 - f. The total harmonic distortion (THD) of each ballast shall in no case exceed 10 percent THD.
 - g. Ballasts shall have a minimum ballast factor of 0.95.
 - h. Ballasts shall have nominal power factor 0.99 or higher.
 - i. Ballasts shall have a maximum lamp current crest factor of 1.5.
 - j. Ballasts shall provide normal rated life for the lamp specified.
 - k. Electronic ballasts shall be Motorola Lighting Inc.; Electronic Ballast Technology; or approved equal.
2. High pressure sodium ballasts shall be of the constant wattage type of the correct size and voltage for the fixture it is to serve as shown on the "Lighting Fixture Schedule". All ballasts shall be as manufactured by Holophane Lighting; MagneTek Universal Manufacturing or approved equal.
3. Metal halide ballast shall be of the constant voltage auto-transformer type of the correct size and voltage for the fixture it is to serve as shown on the "Lighting Fixture Schedule". All ballasts shall be as manufactured by Holophane Lighting; MagneTek Universal Manufacturing; or approved equal.

- E. Flexible Fixture Hangers: Flexible fixture hangers used in non-hazardous areas shall be type ARB and flexible fixture supports used in hazardous areas shall be type ECHF as manufactured by the Crouse-Hinds Co.; Appleton Electric Co.; Killark Electrical Mfg. Co. or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Each fixture shall be a completely finished unit with all components, mounting and/or hanging devices necessary for the proper installation of the particular fixture

in its designated location and shall be completely wired ready for connection to the branch circuit wires at the outlet.

- B. All flush mounted fixtures shall be supported from the structure and shall not be dependent on the hung ceilings for their support.
- C. Fixtures noted to be installed flush in suspended ceilings shall be of mounting types suited for the type ceiling involved. It shall be the responsibility of the Contractor to verify the ceiling types prior to ordering fixtures.
- D. Flexible fixture hangers shall be used for all pendant mounted fixtures. Fixtures two feet long and larger shall be supported with a minimum of two fixture hangers. Pendant fixtures shall be supported from rigid conduit. The use of threaded rods is not acceptable. Provide separate grounding conductor connected to a ground bushing or lug in the outlet box.
- E. Conduit run in areas with hung ceilings shall be installed in the space above the hung ceiling as close to the structure as possible. Conduits shall be supported from the structure.
- F. Fixture locations are shown on the Drawings in approximate locations; however exact locations shall be coordinated so as to avoid conflicts with HVAC ducts, equipment and other obstacles.
- G. Photocells shall be mounted facing north and in a location that is unaffected by light fixture sources.

3.02 REPLACEMENT

- A. Lamps used during construction, except for HID and LED amps, shall be removed and replaced with new lamps two weeks from completion of the work.

3.03 CLEANING UP

- A. Plastic dust cover bags that are provided with new parabolic reflector lighting fixtures shall be removed after all construction activity which may cause dust formation on reflector surfaces has been completed.
- B. All fixtures shall be left in a clean condition, free of dirt and defects, before acceptance by the Construction Manager.

END OF SECTION

APPENDIX 16500-A

LIGHTING FIXTURES

Note: Fixture letter designations used in this Appendix are referenced on the Drawings. The manufacturer and part numbers listed are intended as a guide to the Contractor and are not intended to preclude selection and use of equivalent fixtures made by an alternative manufacturer.

Fixture Type: A

Architectural LED Area Lighting

General: Area led fixture with rugged, die-cast, single-piece aluminum housing. Die-cast doorframe with impact-resistant, tempered glass lens, fully gasketed with one-piece tubular silicone. Corrosion-resistant and weatherproof exterior coating, dark bronze finish. UL Listed

Description:

Manufacturer and model number:

Lithonia Lighting: Type KAD LED with accessories and features as noted or approved equal.

Lamp Type:

1000mA, 30C (30 LEDs), 4000 K

Driver Type:

LED light engine, 0-10V, dimmable
Field adjustable output

Mounting Arrangement:

Pole mount

Input:

Max Wattage (including ballast or driver):

108 W

Voltage:

120 VAC

Notes:

1. Wire guard
2. 8 ft. round aluminum pole with finish to match luminaire, designed to withstand 90 mph steady winds.
3. Pole mounting hardware
4. Type V light distribution

Fixture Type: A1

Architectural LED Area Lighting

General: Area led fixture with rugged, die-cast, single-piece aluminum housing. Die-cast doorframe with impact-resistant, tempered glass lens, fully gasketed with one-piece tubular silicone. Corrosion-resistant and weatherproof exterior coating, dark bronze finish. UL Listed

Description:

Manufacturer and model number:

Lithonia Lighting: Type KAD LED with accessories and features as noted or approved equal.

Lamp Type:

1000mA, 30C (30 LEDs), 4000 K

Driver Type:

LED light engine, 0-10V
Field adjustable output

Mounting Arrangement:

Pole mount

Input:

Max Wattage (including ballast or driver):

108 W

Voltage:

120 VAC

Notes:

1. Photocell control
2. Wire guard
3. 8 ft. round aluminum pole with finish to match luminaire, designed to withstand 90 mph steady winds.
4. Pole mounting hardware
5. Type III light distribution

Fixture Type: B

Outdoor LED Downlight

General: Downlight LED fixture with rugged, die-cast, single-piece aluminum housing. Die-cast doorframe with impact-resistant, tempered glass lens, fully sealed with silicone gasket. Corrosion-resistant and weatherproof exterior coating, dark bronze finish. UL Listed

Description:

Manufacturer and model number:

Lithonia: Type ASW1 LED with accessories and features as noted or approved equal.

Lamp Type:

530mA, 42C (42 LEDs), 3000 K

Driver Type:

LED light engine, 0-10V
Field adjustable output

Mounting Arrangement:

Wall mount

Input:

Max Wattage (including ballast or driver):

75 W

Voltage:

120 VAC

Notes:

1. Surface mounting hardware
2. Wire guard
3. Vandal guard
4. Type III light distribution

Fixture Type: C

General Purpose Industrial LED

General: UV Stabilized, impact resistant, clear polycarbonate housing with closed cell gasket. 20-gage steel channel and channel cover. Captive tamper resistant polycarbonate latches; aluminum reflector for wide light distribution. UL Listed for wet or damp locations.

Type:

Manufacturer and model number:

Lithonia: VAP LED with accessories and features as noted
or approved equal.

Lamp Type:

4000 lumens, 80 CRI, 4000K LED

Driver Type:

LED Light Engine, 0-10V

Mounting Arrangement:

Pendant or surface mounted

Input:

Max Wattage (including ballast or driver):

42 W

Voltage:

120 VAC

Notes:

1. Wet location fittings
2. Lens safety clip
3. Hanging assembly hardware, corrosion resistant.
4. Wide light distribution