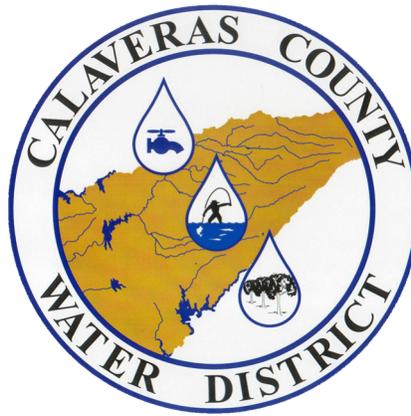


# ARNOLD WWTF PHASE I IMPROVEMENTS PROJECT

*CCWD CIP No. 15095*

BID PACKAGE

October, 2025



Proposal will be received at the office of:

Calaveras County Water District  
120 Toma Court  
San Andreas, California 95249  
no later than

**2:00 p.m. local time on December 16, 2025**



Committed to the future of rural communities.

**Financed by United States Department of Agriculture (USDA) Rural Development**

# SIGNATURE PAGE

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## ARNOLD WWTF PHASE I IMPROVEMENTS PROJECT

### Licensee Responsible For Specifications

The Contract Documents were prepared by or under the direction of the following registered persons:

William J. Slenter, P.E.



Thinh Thanh Le, P.E.



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### **CALAVERAS COUNTY WATER DISTRICT ARNOLD WWTF PHASE I IMPROVEMENTS PROJECT**

Sealed bids for the construction of the Arnold WWTF Phase I Improvements Project will be received by Calaveras County Water District at the office of Calaveras County Water District at 120 Toma Court, San Andreas California 95249 until **2:00 PM local time on December 16, 2025**, at which time the Bids will be publicly opened and read.

This Project is located in Calaveras County and work will take place at the Arnold WWTF. This project will add a new secondary clarifier with new effluent pump, new metering and flow splitting structures, replacement Return Activated Sludge and Waste Activated Sludge (RAS/WAS) pump station, two additional aerobic digesters with submersible self-aspirating aerators, new electrical and control building with new motor control center and master control panel, upgraded PG&E power service, new generator, and associated improvements to yard piping, grading, paving, power and control conduit and wiring, instrumentation, and PLC/SCADA controls. The work involves upgrading an existing wastewater treatment process and complete replacement of the electrical and control system for that facility. Careful sequencing and coordination of the work in accordance with contract requirements and best practices will be required to maintain existing facility operations and avoid unplanned interruptions.

The Engineer's estimate of probable construction cost is \$8.5 million.

The Bidding Documents are available at:

Calaveras County Water District  
120 Toma Court  
San Andreas, CA 95249  
Phone (209) 754-3181  
Attn: Haley Airola, [haleya@ccwd.org](mailto:haleya@ccwd.org)

Dodge Data & Analytics  
4300 Beltway Place, Suite 180  
Arlington TX, 76018  
Phone: (800) 393-6343

Sacramento Regional Builders Exchange  
5370 Elvas Avenue  
Sacramento, CA 95819  
Phone: (916) 442-8991

Placer County Builders Exchange  
10656 Industrial Ave, Suite 160  
Roseville, CA 95678  
Phone: (916) 771-7229

Builders' Exchange of Stockton  
4561 Quail Lakes Drive, Suite B-2  
Stockton, CA 95207  
Phone: (209) 478-1000

Bay Area Builders Exchange  
3055 Alvarado Street  
San Leandro, CA 94577  
Phone: (510) 483-8880

Valley Builders Exchange  
1118 Kansas Avenue  
Modesto, CA 95351  
Phone: (209) 522-9031

Central CA Builders Exchange  
1244 N Mariposa Street  
Fresno, CA 93703  
Phone: (559) 237-1837

Questions regarding the Bidding Documents shall be directed to:

Calaveras County Water District  
120 Toma Court  
San Andreas, CA 95249  
Phone (209) 754-3181  
Attn: Haley Airola, [haleya@ccwd.org](mailto:haleya@ccwd.org)

A pre-bid conference will be held at **10:00 am local time on November 19, 2025** at the Arnold WWTF located at 3294 Hwy 4, Arnold, CA 95223. Attendance at the pre-bid conference is highly encouraged but is not mandatory.

Prospective Bidders shall be licensed Contractors in the State of California and shall be skilled and regularly engaged in the general class or type of work called for under the Contract. Each Bidder shall have a Class A – General Engineering California Contractor's license. Bidders shall submit a statement of qualifications and at least three (3) references of representative clarifier projects. The bidders experience shall include installation of an clarifier system within the past five (5) years.

Bidders are notified that financing for this project is provided pursuant to the Consolidated Farm and Rural Development Act (7 U.S.C. Section 1921 et seq.) and that as allowed in Public Contract Code Section 22300, this contract does not provide for substitution of securities for any monies withheld by the Owner to ensure performance under this contract. Bidders are further notified that this contract does not permit retainage to be placed in escrow nor to be invested for the benefit of the contractor.

This project is subject to the Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, Sections 70901-70953. Absent an approved waiver, all iron, steel, manufactured products and construction materials used in this project must be produced in the United States. The following waivers apply to this project: BABAA De Minimis, Small Grants, and Minor Components.

Owner: Calaveras County Water District  
By: Kevin Williams  
Title: District Engineer  
Date: October 17, 2025

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# SECTION 00200 INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACT

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CIP 15095  
Arnold WWTF Phase I Improvements Project

00200-1

Instruction to Bidders for Construction Contract  
June 2025

Article 27 - Registration with Department of Industrial Relations

**ARTICLE 1 - DEFINED TERMS**

- 1.1 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, and which registers plan holders.
  - B. Domestic Preference – The Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953.

**ARTICLE 2 - BIDDING DOCUMENTS**

- 2.1 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder’s responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.
- 2.2 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use. Authorization to download documents, or other distribution, includes the right for plan holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the plan holder pays all costs associated with printing or reproduction. Printed documents may not be re-sold under any circumstances.
- 2.3 Owner has established a Bidding Documents Website as indicated in the Advertisement or invitation to bid. Owner recommends that Bidder register as a plan holder with the Issuing Office at such website, and obtain a complete set of the Bidding Documents form such website. Bidders may rely that sets of Bidding Documents obtained from the Bidding Documents Website are complete, unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.
- 2.4 Bidder may register as a plan holder and obtain complete sets of Bidding Documents, in the number and format stated in the Advertisement or invitation to bid, from the Issuing Office. Bidders may rely that sets of Bidding Documents obtained from the Issuing Office are complete, unless an omission is blatant. Registered plan holders will receive Addenda issued by Owner.
- 2.5 Plan rooms (including construction information subscription services, and electronic and virtual plan rooms) may distribute the Bidding Documents or make them available for examination. Those prospective bidders that obtain an electronic (digital) copy of the Bidding Documents from a plan room are encouraged to register as plan holders from the Bidding Documents Website or Issuing Office. Owner is not responsible for omissions in Bidding Documents or other documents obtained from plan rooms, or for a Bidder’s failure to obtain Addenda from a plan room.
- 2.6 Electronic Documents
  - A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to the Bidders as Electronic Documents in the manner specified.

1. Bidding Documents will be provided in Adobe PDF (Portable Document Format) (.pdf) that is readable by Adobe Acrobat Reader Version XI or later. It is the intent of the Engineer and Owner that such Electronic Documents are to be exactly representative of the paper copies of the documents. However, because the Owner and Engineer cannot totally control the transmission and receipt of Electronic Documents nor the Contractor's means of reproduction of such documents, the Owner and Engineer cannot and do not guarantee that Electronic Documents and reproductions prepared from those versions are identical in every manner to the paper copies.
- B. Unless otherwise stated in the Bidding Documents, the Bidder may use and rely upon complete sets of Electronic Documents of the Bidding Documents, described in Paragraph 2.06.A above. However, Bidder assumes all risks associated with differences arising from transmission/receipt of Electronic Documents versions of Bidding Documents and reproductions prepared from those versions and, further, assumes all risks, costs, and responsibility associated with use of the Electronic Documents versions to derive information that is not explicitly contained in printed paper versions of the documents, and for Bidder's reliance upon such derived information.
- C. Deleted.

### ARTICLE 3 - QUALIFICATIONS OF BIDDERS

- 3.1 To demonstrate Bidder's qualifications to perform the Work, after submitting its Bid and within **five** days of Owner's request, Bidder must submit the following information:
  - A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments:
    1. Bidders shall submit a statement of qualifications and at least three (3) references of representative wastewater treatment plant upgrade projects. The bidders experience shall include modification of similar wastewater treatment facilities of similar size involving structural, mechanical, electrical, instrumentation and controls upgrades within the past five (5) years. A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract
  - B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.
  - C. Bidder's state or other contractor license number:
    1. The Bidder is required to have a valid, active license issued by the California, Contractors State License Board. The Bidder shall have a Class A General Engineering Contractor license.
  - D. Subcontractor and Supplier qualification information.
    1. Subcontractors and Suppliers are required to have a valid, active license issued by the California, Contractors State License Board.
- 3.2 Deleted.
- 3.3 Bidder is to submit the following information with its Bid to demonstrate Bidder's qualifications to perform the Work:
  - A. Written evidence establishing its qualifications such as financial data, previous experience, and present commitments.
  - B. A written statement that Bidder is authorized to do business in the state where the Project is located, or a written certification that Bidder will obtain such authority prior to the Effective Date of the Contract.

- C. Bidder's state or other contractor license number, if applicable.
  - D. Subcontractor and Supplier qualification information.
  - E. Other required information regarding qualifications.
- 3.4 A Bidder's failure to submit required qualification information within the times indicated may disqualify Bidder from receiving an award of the Contract.
- 3.5 No requirement in this Article 3 to submit information will prejudice the right of Owner to seek additional pertinent information regarding Bidder's qualifications.

#### **ARTICLE 4 - PRE-BID CONFERENCE**

- 4.1 A non-mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference; however, attendance at this conference is not required to submit a Bid.
- 4.2 Information presented at the pre-bid conference does not alter the Contract Documents. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-Bid conference. Information presented, and statements made at the pre-Bid conference will not be binding or legally effective, unless incorporated in an Addendum.

#### **ARTICLE 5 – SITE AND OTHER AREAS; EXISTING SITE CONDITIONS; EXAMINATION OF SITE; OWNER'S SAFETY PROGRAM; OTHER WORK AT THE SITE**

##### 5.1 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 the Contractor.

##### 5.2 Existing Site Conditions

- A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

- 1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:
  - a. Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Bidding Documents.
  - b. Those drawings of physical conditions in or relating to existing surface and subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Bidding Documents.
  - c. Reports and drawings known to the 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.



issued by a surety meeting the requirements of Paragraph 6.01 of the General Conditions. Such bid bond will be issued in the form included in the Bidding Documents. Bid security must be at least 5% of the Bidder's maximum Bid price.

- 8.2 The Bid security of the Successful Bidder will be retained until Owner awards the contract to such Bidder, and such Bidder has executed the Contract, 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 and furnish the required contract security within 15 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.
- 8.3 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 7 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.
- 8.4 The Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within 7 days after the Bid opening.

## **ARTICLE 9 - CONTRACT TIMES**

- 9.1 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and completed and (b) ready for final payment, and (c) Milestones (if any) are to be achieved, are set forth in the Agreement.
- 9.2 Deleted.
- 9.3 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 10 – SUBSTITUTE AND “OR EQUAL” ITEMS**

- 10.1 Deleted.
- 10.2 The Contract for the Work, as awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents, and those “or-equal” or substitute or materials and equipment subsequently approved by Engineer prior to the submittal of Bids and identified by Addendum. No item of material or equipment will be considered by Engineer as an “or-equal” or substitute unless written request for approval has been submitted by Bidder and has been received by Engineer within 10 days of the issuance of the Advertisement for Bids or invitation to Bidders. Each such request must comply with the requirements of Paragraphs 7.05 and 7.06 of the General Conditions, and the review of the request will be governed by the principles in those paragraphs. Each such request shall include the Manufacturers' Certification for Compliance with Domestic Preference requirements. Refer to the suggested Manufacture's Certification provided in these construction Contract Documents. The burden of proof of the merit of the proposed item is upon Bidder. Engineer's decision of approval or disapproval of a proposed item will be final. If Engineer approves any such proposed item, such approval will be set forth in an Addendum issued to all registered Bidders. Bidders cannot rely upon approvals made in any other manner. Substitutes and “or-equal” materials and equipment may be proposed by Contractor in accordance with Paragraphs 7.05 and 7.06 of the General Conditions after the Effective Date of the

Contract. Each such request shall include Manufacturer's Certification letter to document compliance with Domestic Preference requirements. Refer to Manufacturer's Certification Letter provided in these Contract Documents

- 10.3 All prices that Bidder sets forth in its Bid will 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 11 – SUBCONTRACTORS, SUPPLIERS, AND OTHERS**

11.1 Deleted.

11.2 The apparent Successful Bidder, and any other Bidder so requested, must submit to Owner a list of the Subcontractors or Suppliers proposed for the following portions of the Work within five days after Bid opening:

- A. Electrical;
- B. Coatings;
- C. Major mechanical equipment;
- D. System integration

11.3 If requested by Owner, such list must be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor or Supplier. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor or Supplier, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder will submit a substitute, Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.

11.4 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors and Suppliers. Declining to make requested substitutions will constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor or Supplier, so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to subsequent revocation of such acceptance as provided in Paragraph 7.07 of the General Conditions.

11.5 The Contractor shall not award work to Subcontractor(s) in excess of the limits stated in SC 7.07A.

## **ARTICLE 12 – PREPARATION OF BID**

12.1 The Bid Form is included with the Bidding Documents.

- A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
  - B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects too not furnish pricing for such optional alternate item, then Bidder may enter the words “No Bid” or “Not Applicable.”
- 12.2 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents, The printed copy of the Bid Form must be clearly legible, printed on 8 1/2-inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.
- 12.3 A bid by a corporation must 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 must be shown.
- 12.4 A bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.
- 12.5 A Bid by a limited liability company must 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 must be shown.
- 12.6 A bid by an individual must show the Bidder’s name and official address.
- 12.7 A bid by a joint venture must be executed by an authorized representative of each joint venture in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.
- 12.8 All names must be printed in ink below the signatures.
- 12.9 The Bid must contain an acknowledgement of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.
- 12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be shown.
- 12.11 The Bid must contain evidence of a Bidder’s authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.

- 12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder's licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

## **ARTICLE 13 - BASIS OF BID**

13.1 Deleted

13.2 Base Bid with Alternates

- A. Bidders must 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.

13.3 Deleted

13.4 Deleted

13.5 Unit Price

- A. Bidders must submit a Bid on a unit price basis for each item of Work listed in the unit price section of the Bid Form.
- B. The "Bid Price" (sometimes referred to as the extended price) for each unit price Bid item will be the product of the "Estimated Quantity", which Owner or its representative has set forth in the Bid Form, for the item and the corresponding "Bid Unit Price" offered by the Bidder. The total of all unit price Bid items will be the sum of these "Bid Prices"; such total will be used by Owner for Bid comparison purposes. The final quantities and Contract Price will be determined in accordance with Paragraph 13.03 of the General Conditions.
- C. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum.

13.6 Allowances

- A. For cash allowances, the Bid price must 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.

13.7 Deleted

## **ARTICLE 14 – SUBMITTAL OF BID**

- 14.1 The Bidding Documents include one separate unbound copy of the Bid Form, and, if required, the Bid Bond Form. The unbound copy of the Bid Form is to be completed and submitted with the Bid security and the other documents required to be submitted under the terms of Article 2 of the Bid Form.
- 14.2 A bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid and must be enclosed in a plainly marked package with the Project title, and if applicable, the designated portion of the Project for which the Bid is submitted, the name and address of Bidder, and must be accompanied by the Bid security and other required documents. If a bid is sent by mail or other delivery system, the sealed envelope containing the Bid must be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED". A mailed bid must be addressed to the location designated in the Advertisement.
- 14.3 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.

#### **ARTICLE 15 - MODIFICATION AND WITHDRAWAL OF BID**

- 15.1 An unopened 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.
- 15.2 If a Bidder wishes to modify its Bid prior to Bid opening, Bidder must withdraw its initial Bid in the manner specified in Paragraph 15.1 and submit a new Bid prior to the date and time for the opening of Bids.
- 15.3 If within 24 hours after Bids are opened and Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

#### **ARTICLE 16 - OPENING OF BIDS**

- 16.1 Bids will be opened at the time and place indicated in the advertisement or invitation to bid 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 17 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE**

- 17.1 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 Bid security prior to the end of this period.

#### **ARTICLE 18 – EVALUATION OF BIDS AND AWARD OF CONTRACT**

- 18.1 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner also reserves the right to waive all minor Bid informalities not involving price, time, or changes in the Work.

- 18.2 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible.
- 18.3 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, whether in the Bid itself or in a separate communication to Owner or Engineer, then Owner will reject the Bid as nonresponsive.
- 18.4 If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest responsive Bid.
- 18.5 Evaluation of Bids
- A. In evaluating Bids, Owner will consider whether 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.
  - B. In the comparison of Bids, alternates will be applied in the same order of priority as listed in the Bid Form. To determine the Bid prices for purposes of comparison, Owner will announce to all bidders a "Base Bid plus alternates" budget after receiving all Bids, but prior to opening them. For comparison purposes alternates will be accepted, following the order of priority established in the Bid Form, until doing so would cause the budget to be exceeded. After determination of the Successful Bidder based on this comparative process and on the responsiveness, responsibility, and other factors set forth in these instructions, the award may be made to said Successful Bidder on its base Bid and any combination of its additive alternate Bids for which Owner determines funds will be available at the time of award.
  - C. For determination of the apparent low Bidder(s) when sectional bids are submitted, Bids will be compared on the basis of the aggregate of the Bids for separate sections and the Bids for combined sections that result in the lowest total amount for all of the Work.
  - D. For determination of the apparent low Bidder when unit prices are submitted, Bids will be compared on the basis of the total of the products of the estimated quantity of each item and unit price Bid for that item, together with any lump sum items.
  - E. Deleted
  - F. Deleted
- 18.6 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 identify of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 18.7 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.

## **ARTICLE 19 – BONDS AND INSURANCE**

- 19.1 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, other required bonds (if any), and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by required bonds and insurance documentation.
- 19.2 Article 8, Bid Security, of these instructions, addresses any requirements for providing bid bonds as part of the bidding process.

## **ARTICLE 20 – SIGNING OF AGREEMENT**

- 20.1 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unexecuted counterparts of the Agreement along with the other Contract Documents as identified in the Agreement. Within 15 days thereafter, Successful Bidder must execute and deliver the required number of counterparts of the Agreement and any bonds and insurance documentation required to be delivered by the Contract Documents to Owner. Within 10 days thereafter, Owner will deliver one fully executed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

## **ARTICLE 21 - SALES AND USE TAXES**

- 21.1 Contractor shall pay all sales, use and other taxes as specified in Paragraph 7.10 of the General Conditions.

## **ARTICLE 22 – CONTRACTS TO BE ASSIGNED**

- 22.1 There are no procurement contracts of which the Contractor will be required to accept assignment previously entered into by the Owner for the direct purchase of goods and special services.

## **ARTICLE 23 – FEDERAL REQUIREMENTS**

- 23.1 If the contract price is in excess of \$100,000, provisions of the Contract Work Hours and Safety Standards Act at 29 CFR 5.5(b) apply.
- 23.2 Federal requirements at Article 19 of the Supplemental Conditions apply to this Contract.

## **ARTICLE 24 - WORKERS' COMPENSATION REQUIREMENTS**

- 24.1 As required by Section 1860 of the California Labor Code and in accordance with the provisions of Section 3700 of the Labor Code, every contractor will be required to secure the payment of workers' compensation to its employees.
- 24.2 In accordance with Section 1861 of the California Labor Code, the contractor shall furnish the owner with a statement as follows: "I am aware of the provisions of 3700 of the Labor Code which requires 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."

## ARTICLE 25 – WAGE RATE REQUIREMENTS

- 25.1 The prevailing wage rates of the State of California apply to this contract as do any requirements of the State of California associated with the use of these State Prevailing wages.
- 25.2 Prevailing Wages: Notice is hereby given that pursuant to 1773 of the Labor Code of the State of California, the owner has obtained from the Director of the Department of Industrial Relations the general prevailing rate of per diem wages and the general prevailing rate for holidays and overtime work for each craft, classification, or type of worker required to execute the contract. A copy of said prevailing rate of per diem wages is on file in the principal office of the owner, to which reference is hereby made for further particulars. Said prevailing rate of per diem wages will be made available to any interested party upon request, and a copy thereof shall be posted at each job site.
- 25.3 Statutory Penalty For Failure to Pay Minimum Wages: In accordance with 1775 (a) through (c) of the California Labor Code, the contractor shall as a penalty to the State of political subdivision on whose behalf a contract is made or awarded, forfeit the current statutory penalty for each calendar day or portion thereof, for each worker paid less than the prevailing wage rates as determined by the director for the work or craft in which the worker is employed for any public work done under the contract by the contractor or, except as provided in subdivision 1775 (b), by any subcontractor under the contractor.
- 25.4 Statutory Penalty for Unauthorized Overtime Work: In accordance with Section 1813 of the California Labor Code, the contractor shall as a penalty to the State or political subdivision on whose behalf the contract is made or awarded, forfeit the current statutory penalty for each worker employed in the execution of the contract by the respective contractor or subcontractor for each calendar day during which said worker is required or permitted to work more than 8 hours in any one calendar day and 40 hours in any one calendar week in violation of Sections 1810-1815 of the California Labor Code.
- 25.5 Requirements: Contractor agrees to comply with Sections 1777.5, 1777.6 and 1777.7 of the California Labor Code relating to the employment of apprentices. The responsibility for compliance with these provisions is fixed with the prime contractor for all apprenticeship occupations. Under these sections of the law, contractors and subcontractors must employ apprentices in apprenticeship occupations, where journeymen in the craft are employed on the public work, in a ratio of not less than one apprentice hour for each five journeymen hours (unless an exemption is granted in accordance with 1777.5) and contractors and subcontractors shall not discriminate among otherwise qualified employees as indentured apprentices on any public work solely on the ground of race, religious creed, color, national origin, ancestry, sex, or age, except as provided in 3077 of the Labor Code. Only apprentices, as defined in 3077, which provides that an apprentice must be at least 16 years of age, who are in training under apprenticeship standards and who have signed written apprentice agreements will be employed on public works in apprenticeship occupations.
- 25.6 Payroll Records: Contractor shall keep accurate payroll records in format specified by the Division of Labor Standards Enforcement. Said information shall include, but not be limited to, a record of the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and actual per diem wages paid to each journeyman, apprentice, or worker employed by the contractor. Copies of such record shall be made available for inspection at all reasonable hours, and a copy shall be made available to employee or his authorized representative, the Division of Labor

Standards Enforcement, and the Division of Apprenticeship Standards in compliance with California Labor Code, Section 1776. Contractor and subcontractors shall furnish and submit electronic certified payrolls directly to the Labor Commissioner, and duplicate copies available to the owner.

## **ARTICLE 26 – SUBCONTRACTOR LISTING LAW**

- 26.1 In accordance with Section 4104 of the California Public Contract Code, each bidder, in his or her bid, shall set forth the name and the location of the place of business of each subcontractor who will perform work or labor or render service to the prime contractor in or about the construction of the work or improvement, or a subcontractor licensed by the State of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications, in an amount in excess of one-half of one percent of the prime contractor's total Lump Sum bid.
- 26.2 In accordance with Section 4107 of the California Public Contract Code, no contractor whose bid is accepted shall without consent of the owner either: (a) substitute a person as a subcontractor in place of the subcontractor listed in the original bid; or (b) permit a subcontract to be voluntarily assigned or transferred or allow it to be performed by anyone other than the original subcontractor listed in the original bid; or (c) sublet or subcontract any portion of the work in excess of one-half of one percent of the prime contractor's total bid as to which his or her original bid did not designate a subcontractor.
- 26.3 Penalties for failure to comply with the foregoing sections of the California Public Contract Code are set forth in Sections 4106, 4110, and 4111 of the Public Contract Code. A prime contractor violating this law violates his or her contract and the awarding authority may exercise the option, in its own discretion, of (1) canceling his or her contract or (2) assessing the prime contractor a penalty in an amount of not more than 10 percent of the amount of the subcontract involved, and this penalty shall be deposited in the fund out of which the prime contract is awarded. In any proceedings under this section the prime contractor shall be entitled to a public hearing and to five day's notice of the time and place thereof.

## **ARTICLE 27 – REGISTRATION WITH DEPARTMENT OF INDUSTRIAL RELATIONS**

- 27.1 This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations. No contractor or subcontractor may be listed on a bid proposal for a public works project 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 1711.1(a)]. No contractor or subcontractor may be awarded a contract for public work on a public work on a public works project unless registered with the Department of Industrial Relations pursuant to Labor Code Section.

## **SECTION 00211 SEQUENCE OF CONSTRUCTION**

### **1.0 GENERAL**

The project consists of work within the limits of the Arnold WWTF. Work should be scheduled in organized sequence to allow the District to limit shutdowns of the existing Arnold WWTF and maintain operation throughout construction. Contractor shall refer to Specifications Division 1 and elsewhere in the plans and specifications for additional sequencing requirements and constraints.

### **2.0 PROJECT SCHEDULE**

The Contractor shall provide the District a project schedule within 10 days of the District issuing the Notice to Proceed and prior to the Preconstruction Meeting. The schedule should be organized by process areas as it relates to the Arnold WWTF. Equipment delivery lead times and anticipated shutdowns of the plant must be added to the schedule.

### **4.0 WEATHER**

The project specifications provide the estimated number of weather days that can be expected each month. Arnold WWTF is located at a higher altitude and snow can accumulate up to several feet during the winter months. The Contractor will only be allowed to work at the Arnold WWTF between **April 15<sup>th</sup> - November 30<sup>th</sup>**.

### **5.0 MATERIALS – NOT USED**

### **6.0 EXECUTION – NOT USED**

**END OF SECTION**

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# **SECTION 00410**

## **BID FORM**

### **ARNOLD WWTF PHASE I IMPROVEMENTS PROJECT**

#### **ARTICLE 1 – OWNER AND BIDDER**

1.1 This Bid is submitted to:

Calaveras County Water District  
120 Toma Court  
San Andreas CA

1.2 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 – ATTACHMENTS TO THIS BID**

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

- A. Required Bid security;
- B. List of Proposed Subcontractors;
- C. Evidence of authority to do business in the state of the Project; or a written covenant to obtain such authority within the time for acceptance of Bids;
- D. Contractor's license number as evidence of Bidder's State Contractor's License or a covenant by Bidder to obtain said license within the time for acceptance of Bids;
- E. Required Bidder Qualification Statement with supporting data;
- F. If Bid amount exceeds \$25,000, signed Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions (AD-1048);
- G. If Bid amount exceeds \$100,000, signed RD Instruction 1940-Q Exhibit A-1, Certification for Contracts, Grants, and Loans;
- H. Non-Collusion Affidavit;
- I. Workers' Compensation;
- J. Evidence of authority to do business in California; or a written covenant to obtain such license within the time for acceptance of Bids;
- K. Evidence of Contractor's License Number 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;

#### **ARTICLE 3 - BASIS OF BID- LUMP SUMS/UNIT PRICES**

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

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Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
<b>GENERAL</b>					
1	Mobilization/Demobilization	LS	1		
2	Sheeting, Shoring and Bracing	LS	1		
3	Water Pollution Control Plan Compliance	LS	1		
4	Startup, Testing, Documentation, and Training	LS	1		
<b>DEMOLITION &amp; TEMPORARY FACILITIES</b>					
5	Rock Allowance	CY	30		
6	Demolition and Site Preparation	LS	1		
7	Tree Removal	LS	1		
<b>SITWORK &amp; MECHANICAL</b>					
8	Earthwork, Grading, and Retaining Walls	LS	1		
9	Drainage Facilities	LS	1		
10	AB Access Road and AB Surfaces	CY	96		
11	Gravel Surfacing	CY	98		
12	Cast-in-Place Sitework Concrete	LS	1		
13	Cast-in-Place Structural Concrete	LS	1		
14	Coating of Concrete Structures	SF	1,220		
15	CMU Control Building	LS	1		
16	Yard Piping and Appurtenances	LS	1		
17	Stairs and Handrailing	LS	1		
18	Covers, Hatches, and Platforms	LS	1		
19	Circular Clarifier Equipment, Piping, and Accessories	LS	1		
20	Mixed Liquor Flow Control System Equipment, Piping, and Accessories	LS	1		
21	Vertical Turbine Pump Equipment, Piping, and Accessories	LS	1		
22	RAS/WAS Pumps Equipment, Piping, and Accessories	LS	1		

Item No.	Description	Unit	Estimated Quantity	Bid Unit Price	Bid Price
23	Digester Mixer and Diffuser Equipment, Piping, and Accessories	LS	1		
24	Digester Blowers, Piping, and Accessories	LS	1		
<b>ELECTRICAL, INSTRUMENTATION AND CONTROLS</b>					
25	Site Electrical Improvements	LS	1		
26	Switchboard, Control Panels, and MCC	LS	1		
27	Emergency Generator	LS	1		
28	Field Instrumentation and System Integration	LS	1		
29	Electrical Service Upgrade	LS	1		
<b>Total Base Bid, Items 1 through 29, inclusive and all work incidental thereto, and connected therewith</b>					\$
30	2" AC Pavement Overlay (Additive Alternative Bid Item)	SF	5,470		
<b>Total Base Bid Items 1 through 29, plus Additive Alternative Bid Item 30, inclusive and all work incidental thereto, and connected therewith</b>					\$

\_\_\_\_\_ DOLLARS

**TOTAL BASE BID AMOUNT (WRITTEN)**

\_\_\_\_\_ DOLLARS

**TOTAL BASE BID PLUS ADDITIVE ALTERNATIVE BID ITEM(S) AMOUNT (WRITTEN)**

Bidder acknowledges that:

1. Each Bid Unit Price includes an amount considered by Bidder to be adequate to cover Contractor's overhead and profit for each separately identified item, and
2. Estimated quantities are not guaranteed, and are solely for the purposes of comparison of Bids, and final payment for all Unit Price Work will be based on actual quantities as determined as provided in the Contract Documents.

## DESCRIPTIONS OF BID ITEMS

### **BID ITEM NO. 1 – MOBILIZATION/DEMobilIZATION**

The contract lump sum price paid for this item consists of preparatory work and operations, including, but not limited to those necessary for the movement of personnel, equipment, supplies, and incidentals to the site; securing performance and payment bonds and required insurance, establishing a field office (if applicable) and staging areas; preparing schedules and sequencing plans, submitting shop drawings; and for all other work and operations to be performed, or costs incurred, prior to beginning the Work. Contractor shall provide and maintain portable toilet(s) on-site for use by Contractor and subcontractor employees. Demobilization shall include, but not limited to, removal of all waste materials, debris, final cleanup of construction and staging areas, and issuance of maintenance bond. Contractor shall submit no greater than four percent (4%) of the total Contract Sum for this Bid Item.

### **BID ITEM NO. 2 – SHEETING, SHORING & BRACING**

The contract lump sum price paid for this item shall include full compensation for furnishing of all materials, equipment, labor, and incidentals required to provide sheeting, shoring, bracing, and incidental work, complete, in accordance with Section 02350.

### **BID ITEM NO. 3 – WATER POLLUTION CONTROL PLAN COMPLIANCE**

The contract lump sum price paid for this item includes full compensation for preparation, submission, and re-submission of a Water Pollution Control Plan for approval by the Engineer prior to commencing any field work. The plan shall be prepared in accordance with requirements set forth in Section 01500. The lump sum price shall also include full compensation for furnishing of all transportation, labor, materials, tools, equipment, and all incidental work for implementing the Water Pollution Control Plan for the project.

### **BID ITEM NO. 4 –STARTUP, TESTING, DOCUMENTATION, AND TRAINING**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to complete startup, testing, commissioning, operator training, and provide operations and maintenance documentation, in full compliance with the Drawings and Specifications including, but not limited to, Sections 01360, 01660, and 01661 and the relevant requirements of the Technical Specifications.

### **BID ITEM NO. 5 – ROCK ALLOWANCE**

The contract unit price paid per cubic yard for this item includes furnishing all materials, equipment, labor, dewatering, hauling, and off-site disposal of rock (if not suitable for onsite fill) to remove all rock encountered within excavations and the exposed rock to be demolished as shown on the Drawings based on the quantity of rock excavated as defined in Section 02200 2.01 D. This bid item is an allowance item and payment for this work will be based on actual work completed.

### **BID ITEM NO. 6 – DEMOLITION AND SITE PREPARATION**

The contract lump sum price paid for this item includes all demolition, removal, disposal, clearing, grubbing, and related site preparation work in accordance with Section 02055, as indicated on the Drawings, and as incidental to the work, except tree removal.

### **BID ITEM NO. 7 – TREE REMOVAL**

The contract lump sum price paid for this item includes removal and disposal of existing trees and tree stumps as indicated on the Drawings.

### **BID ITEM NO. 8 – EARTHWORK, GRADING, AND RETAINING WALLS**

The contract lump sum price paid for this item includes all earthwork, excavation, dewatering, hauling, compacting, import of materials, grading, protection of structures and utilities not intended for removal, dust and noise control, material disposal, fees, and all incidentals, and furnishing and installing the gravity setback retaining wall, as indicated on the Drawings and as specified.

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**BID ITEM NO. 9 – DRAINAGE FACILITIES**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install new precast drainage inlets, trench drains, swales, outlets, and drainage piping as shown on the Drawings and as specified.

**BID ITEM NO. 10 – AB ACCESS ROAD AND AB SURFACES**

The contract unit price paid per cubic yard for this item includes furnishing all materials, equipment, and labor required to prepare the site and install 6" and 12" Class II aggregate base (AB) pavement in the locations shown on the Drawings.

**BID ITEM NO. 11 – GRAVEL SURFACING**

The contract unit price paid per cubic yard for this item includes furnishing all materials, equipment, and labor required to prepare the site and install 3/4" gravel surfacing in the locations shown on the Drawings.

**BID ITEM NO. 12 – CAST-IN-PLACE SITEWORK CONCRETE**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install cast-in-place sitework concrete, including import of materials, aggregate base (AB), compaction, formwork, steel reinforcement, joints, placement, curing, finishing, and restoration of adjacent surfaces as indicated on the Drawings and in accordance with Section 03310.

**BID ITEM NO. 13 – CAST-IN-PLACE STRUCTURAL CONCRETE**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install cast-in-place structural concrete, including import of materials, aggregate base (AB), compaction, formwork, steel reinforcement, joints, placement, curing, and finishing as indicated on the Drawings and in accordance with Section 03300, and elsewhere as specified and shown.

**BID ITEM NO. 14 – COATING OF CONCRETE STRUCTURES**

The contract unit price paid per square foot for this item includes furnishing all materials, equipment, and labor required to perform surface preparation and install interior protective coatings on concrete wastewater process structures as indicated on the Drawings, in accordance with Section 09900, and elsewhere as specified and shown.

**BID ITEM NO. 15 – CMU CONTROL BUILDING**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the new control building, complete, including reinforced concrete masonry unit (CMU) walls, wood truss roof structure, standing seam metal roof, doors, lintel, insulation, drywall, and insulation as indicated on the Drawings and as specified.

**BID ITEM NO. 16 – YARD PIPING AND APPURTENANCES**

The contract lump sum price paid for this item includes furnishing all materials, equipment, labor and incidentals required to install new buried yard piping and buried valves and appurtenances as shown and as specified, including locating utilities, potholing prior to construction, excavation, existing pipe dewatering, new pipe, pipe encasement, valves, valve boxes, fittings, couplings, restraint, testing, corrosion protection, bedding, backfill, transport and disposal of materials. This item also includes making connections to existing yard piping and temporary provisions required to sequence the interconnection with existing facilities while protecting facility operations.

**BID ITEM NO. 17 – STAIRS AND HANDRAILING**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install metal stairs and handrails as shown and as specified, excluding stairs and handrailing on the circular secondary clarifier.

**BID ITEM NO. 18 – COVERS, HATCHES, AND PLATFORMS**

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The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install gratings, plating, access hatches, hatch safety systems, platforms, and walkways, complete including connecting hardware and concrete embeds and anchors as shown and specified. excluding the circular secondary clarifier platform.

**BID ITEM NO. 19 – CIRCULAR CLARIFIER EQUIPMENT, PIPING, AND ACCESSORIES**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the circular secondary clarifier equipment and structures including drive unit, walkway, platform, handrail, stairs, center shaft, feed well, channel rack arms and spiral blades, weir plates, baffle plates, scum box, skimmer assembly, scum flushing system, leveling grout, and all other components required for a complete and functional system in accordance with the Drawings, Section 11352, and elsewhere as specified and shown.

**BID ITEM NO. 20 – MIXED LIQUOR FLOW CONTROL SYSTEM, EQUIPMENT, PIPING, AND ACCESSORIES**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the 6" electrically actuated modulating pinch valves, pipe, pipe supports, fittings, couplings and accessories within the mixed liquor flow control vault as shown and specified.

**BID ITEM NO. 21 – VERTICAL TURBINE PUMP EQUIPMENT, PIPING, AND ACCESSORIES**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the vertical turbine effluent pump in the secondary clarifier effluent pump station wet well including pump, motor, box supports, discharge piping, check valve, isolation valve, air release valve, and accessories in accordance with the Drawings, Section 11400, and elsewhere as specified and shown.

**BID ITEM NO. 22 – RAS/WAS PUMPS EQUIPMENT, PIPING, AND ACCESSORIES**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the RAS/WAS reciprocal positive displacement pumps including pumps, motors, pulsation dampeners, discharge piping, check valves, isolation valves, motorized valves, and accessories in accordance with the Drawings, Section 11300, and elsewhere as specified and shown.

**BID ITEM NO. 23 – DIGESTER MIXER AND DIFFUSER EQUIPMENT, PIPING AND ACCESSORIES**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the aerobic digester mixers including motors, reducers, mounting systems, couplings, shaft assemblies, and impeller systems in accordance with the Drawings, Section 11100, and elsewhere as specified and shown.

**BID ITEM NO. 24 – DIGESTER BLOWERS, PIPING, AND ACCESSORIES**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the digester air supply positive displacement blowers in the existing building, including motors, blower housings, impellers, shafts, acoustical enclosures, support frames, silencers, flexible joints, check valves, pressure relief valves, flowmeters, instruments, discharge piping, isolation valves, expansion joints, and accessories in accordance with the Drawings, Section 11410, and elsewhere as specified and shown.

**BID ITEM NO. 25 – SITE ELECTRICAL IMPROVEMENTS**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install new conduit, wire, pullboxes, and accessories to provide for power and signal between panels and field devices, including duct bank excavation, installation, backfill, concrete cap, warning tape, and surface restoration, and all work and all temporary provisions required to sequence electrical improvements while protecting facility operations, as shown and specified and as required for a complete operable system.

**BID ITEM NO. 26 – SWITCHBOARD, CONTROL PANELS, AND MCC**

CIP 15095

00410-6

Bid Form

Arnold WWTF Phase I Improvements Project

June 25

**EJCDC® C-410, Bid Form for Construction Contract.**

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The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the motor control centers, switchboard, and main control panel as shown and specified.

**BID ITEM NO. 27 – EMERGENCY GENERATOR**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the 500kW three phase diesel standby generator complete with sound enclosure, belly fuel tank, and all accessories in accordance with the Drawings, Section 16208, and elsewhere as specified and shown.

**BID ITEM NO. 28 – FIELD INSTRUMENTATION AND SYSTEM INTEGRATION**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install all field instrumentation including flow meters, pressure instruments, level instruments and switches, position switches, other instruments as shown and specified, perform all system integration services for the project, and testing, in accordance with the Drawings, Specifications Division 17, and elsewhere as specified and shown.

**BID ITEM NO. 29 – ELECTRICAL SERVICE UPGRADE**

The contract lump sum price paid for this item includes furnishing all materials, equipment, and labor required to install the power utility service upgrade including meter socket, disconnect, transformer pad, conduit, cabling, service raceway, and accessories as required for a complete installation and in accordance with utility provider requirements in accordance with the Drawings, Section 16400, and elsewhere as specified and shown.

**ADDITIVE ALTERNATIVE BID ITEM NO. 30 – 2” AC OVERLAY**

The contract unit price paid per square foot for this additive alternate bid item includes repair, milling, reinforcing fabric, preparation, and AC overlay placement in accordance with Section 02500 and as indicated on the Drawings.

**ARTICLE 4 – DELETED**

**ARTICLE 5 – DELETED**

**ARTICLE 6 – BIDDERS REPRESENTATIONS AND CERTIFICATIONS**

- 6.1 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.
- 6.2 Deleted
- 6.3 Deleted
- 6.4 Bidder accepts the provision of the Agreement as to liquidated damages.

**ARTICLE 7 – BIDDER’S ACKNOWLEDGEMENTS: ACCEPTANCE PERIOD, INSTRUCTIONS, AND RECEIPT OF ADDENDA**

- 7.1 Bid Acceptance Period
  - A. 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.

7.2 Instructions to Bidders

A. Bidder accepts all of the terms and conditions of the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security.

7.3 Receipt of Addenda

A. Bidder hereby acknowledges receipt of the following Addenda:

Addendum Number	Addendum Date

**ARTICLE 8 – BIDDER’S PRESENTATION AND CERTIFICATION**

8.1 Bidder’s Representations

- A. In submitting this Bid, Bidder represents the following:
  - 1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
  - 2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
  - 3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work, **including all Domestic Preference requirements.**
  - 4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
  - 5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
  - 6. 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 the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder’s (Contractor’s) safety precautions and programs.
  - 7. Based on the information and observations referred to in the preceding paragraph, Bidder 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.
  - 8. 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.

9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

#### *8.2 Bidder's Certifications*

- A. The Bidder certifies the following:
  1. 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.
  2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
  3. Bidder has not solicited or induced any individual or entity to refrain from bidding.
  4. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 8.02.A:
    - a. Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
    - b. 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.
    - c. 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.
    - d. 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.

BIDDER hereby submits this Bid as set forth above:

Bidder:

\_\_\_\_\_  
*(typed or printed name of organization)*

By:

\_\_\_\_\_  
*(individual's signature)*

Name:

\_\_\_\_\_  
*(typed or printed)*

Title:

\_\_\_\_\_  
*(typed or printed)*

Date:

\_\_\_\_\_  
*(typed or printed)*

*If Bidder is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.*

Attest:

\_\_\_\_\_  
*(individual's signature)*

Name:

\_\_\_\_\_  
*(typed or printed)*

Title:

\_\_\_\_\_  
*(typed or printed)*

Date:

\_\_\_\_\_  
*(typed or printed)*

Address for giving notices:

\_\_\_\_\_  
\_\_\_\_\_

Bidder's Contact:

Name:

\_\_\_\_\_  
*(typed or printed)*

Title:

\_\_\_\_\_  
*(typed or printed)*

Phone:

\_\_\_\_\_

Email:

\_\_\_\_\_

Address:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Bidder's Contractor License No.

Employer's Tax ID Number

\_\_\_\_\_

**NON COLLUSION AFFIDAVIT TO BE EXECUTED BY BIDDER  
AND SUBMITTED WITH BID**

(Public Contract Code Section 7106)

State of California  
County of \_\_\_\_\_

\_\_\_\_\_, being first duly sworn, deposes and says that he or she is \_\_\_\_\_ of \_\_\_\_\_, the party making the foregoing bid, that the bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation; that the bid is genuine and not collusive or sham; that the bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding; that the bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract; that all statements contained in the bid are true; and further that the bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

By \_\_\_\_\_

Subscribed and sworn to before me on \_\_\_\_\_  
(date)

\_\_\_\_\_  
(Notary Public)

(SEAL)

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## BID BOND (PENAL SUM FORM)

<b>Bidder</b> Name: Address <i>(principal place of business)</i> :	<b>Surety</b> Name: Address <i>(principal place of business)</i> :
<b>Owner</b> Name: <b>Calaveras County Water District</b> Address <i>(principal place of business)</i> : <b>120 Toma Court</b> <b>San Andreas, CA 95249</b>	<b>Bid</b> Project <i>(name and location)</i> : <b>Calaveras County Water District – Arnold WWTF</b> <b>Phase I Improvements Project, Calaveras County,</b> <b>California</b>  Bid Due Date:
<b>Bond</b> Penal Sum: Date of Bond:	
Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth in this Bid Bond, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.	
Bidder	Surety
<i>(Full formal name of Bidder)</i>	<i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature) (Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<i>Notes: (1) Note: Addresses are to be used for giving any required notice. (2) Provide execution by any additional parties, such as joint venturers, if necessary.</i>	

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 will be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder occurs 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 will 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 does not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action will 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 will be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder must 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 Postal Service registered or certified mail, return receipt requested, postage pre-paid, and will 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 will 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 governs and the remainder of this Bond that is not in conflict therewith continues in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

**COMPLIANCE STATEMENT**

This statement relates to a proposed contract with \_\_\_\_\_

\_\_\_\_\_  
*(Name of borrower or grantee)*

who expects to finance the contract with assistance from either the Rural Housing Service (RHS), Rural Business-Cooperative Service (RBS), or the Rural Utilities Service (RUS) or their successor agencies, United States Department of Agriculture (whether by a loan, grant, loan insurance, guarantee, or other form of financial assistance). I am the undersigned bidder or prospective contractor. I represent that:

1. I  have,  have not, participated in a previous contract or subcontract subject to Executive Order 11246 (regarding equal employment opportunity) or a preceding similar Executive Order.
2. If I have participated in such a contract or subcontract, I  have,  have not, filed all compliance reports that I have been required to file in connection with the contract or subcontract.

If the proposed contract is for \$50,000 or more and I have 50 or more employees, I also represent that:

3. I  have,  have not, previously had contracts subject to the written affirmative action program requirements of the Secretary of Labor.
4. If I have participated in such a contract or subcontract, I  have,  have not, developed and placed on file at each establishment affirmative action programs as required by the rules and regulations of the Secretary of Labor.

I understand that if I have failed to file any compliance reports that have been required or me, I am not eligible and will not be eligible to have my bid considered or to enter into the proposed contract unless and until I make an arrangement regarding such reports that is satisfactory to either the RHS, RBS, or RUS, or to the office where the reports are required to be filed.

I also certify that I do not maintain or provide for my employees any segregated facilities at any of my establishments, and that I do not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I certify further that I will not maintain or provide for my employees any segregated facilities at any of my establishments, and that I will not permit my employees to perform their services at any location, under my control, where segregated facilities are maintained. I agree that a breach of this certification is a violation of the Equal Opportunity clause in my contract. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation and housing facilities provided for employees which are segregated by explicit directive or are in fact segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. I further agree that (except where I have obtained identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause; that I will retain such certifications in my files; and that I will forward the following notice to such proposed subcontractors (except where the proposed subcontractors have submitted identical certifications for specific time periods): (See Reverse).

**NOTICE TO PROSPECTIVE SUBCONTRACTORS OF REQUIREMENTS  
FOR  
CERTIFICATIONS OF NON-SEGREGATED FACILITIES**

A certification of Nonsegregated Facilities, as required by the May 9, 1967, order (32F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a subcontract exceeding \$10,000 which is not exempt from the provisions of the Equal Opportunity Clause. The certification may be submitted either for each subcontract or for all subcontracts during a period (i.e., quarterly, semiannually, or annually)

NOTE: The penalty for making false statements in offers is prescribed in 18 U.S.C. 1001.

Date: \_\_\_\_\_

\_\_\_\_\_  
*Signature of Bidder or Prospective Contractor*

\_\_\_\_\_  
*Address (including Zip Code)*

# U.S. DEPARTMENT OF AGRICULTURE

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## **Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions.**

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This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 7 CFR Part 3017.510, Participants' responsibilities. The regulations were published as Part IV of the January 30, 1989, Federal Register (pages 4722-4733). Copies of the regulations may be obtained by contacting the Department of Agriculture agency with which this transaction originated.

### **(BEFORE COMPLETING CERTIFICATION, READ INSTRUCTIONS ON REVERSE)**

- (1) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.
  
- (2) Where the prospective lower tier participant is unable to certify to any of the statements in  
This certification, such prospective participant shall attach an explanation to this proposal.

---

Organization Name

PR/Award Number or Project Name

---

Name(s) and Title(s) of Authorized Representative(s)

---

Signature(s)

Date

Form AD-1048 (1/92)

## **Instructions for Certification**

1. By signing and submitting this form, the prospective lower tier participant is providing the certification set out on the reverse side in accordance with these instructions.
2. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.
3. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.
4. The terms “covered transaction,” “debarred,” “suspended,” “ineligible,” “lower tier covered transaction,” “participant,” “person,” “primary covered transaction,” “principal,” “proposal,” and “voluntarily excluded,” as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.
5. The prospective lower tier participant agrees by submitting this form that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.
6. The prospective lower tier participant further agrees by submitting this form that it will include this clause titled “Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion – Lower Tier Covered Transactions,” without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
7. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that it is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principles. Each participant may, but is not required to, check the Nonprocurement List.
8. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of a participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.
9. Except for transactions authorized under paragraph 5 of these instructions, if a participant in a covered transaction knowingly entered into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

**Form AD-1048 (1/92)**

**CERTIFICATION FOR CONTRACTS, GRANTS AND LOANS**

The undersigned certifies, to the best of his or her knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant or Federal loan, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant or loan.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant or loan, the undersigned shall complete and submit Standard Form – LLL, “Disclosure of Lobbying Activities,” in accordance with its instructions.

3. The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including contracts, subcontracts, and subgrants under grants and loans) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code.

Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

\_\_\_\_\_  
(Name)

\_\_\_\_\_  
(Date)

\_\_\_\_\_  
(Title)

(08-21-91) PN 171

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**CONTRACTOR'S CERTIFICATION REGARDING WORKERS'  
COMPENSATION INSURANCE**

State of California

County of \_\_\_\_\_

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for workers' 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.

\_\_\_\_\_  
(Name of Contractor)

by: \_\_\_\_\_

\_\_\_\_\_  
(Signature of Contractor)

Date: \_\_\_\_\_

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**NOTICE OF AWARD**

Date of Issuance:

Owner: Calaveras County Water District

Owner's Project No.: 15095

Engineer: HydroScience Engineers, Inc.

Project: Arnold WWTF Phase I Improvements

Contract Name:

Bidder:

Bidder's Address:

You are notified that Owner has accepted your Bid dated \_\_\_\_\_ for the above Contract, and that you are the Successful Bidder and are awarded a Contract for:

**Calaveras County Water District-Arnold WWTF Phase I Improvements Project**

The Contract Price of the awarded Contract is \$\_\_\_\_\_. Contract Price is subject to adjustment based on the provisions of the Contract, including but not limited to those governing changes, Unit Price Work, and Work performed on a cost-plus-fee basis, as applicable.

Three unexecuted counterparts of the Agreement accompany this Notice of Award, and one copy of the Contract Documents accompanies this Notice of Award, or has been transmitted or made available to Bidder electronically.

Drawings will be delivered separately from the other Contract Documents.

You must comply with the following conditions precedent within 15 days of the date of receipt of this Notice of Award:

1. Deliver to Owner three counterparts of the Agreement, signed by Bidder (as Contractor).
2. Deliver with the signed Agreement(s) the Contract security (such as required performance and payment bonds) and insurance documentation, as specified in the Instructions to Bidders and in the General Conditions, Articles 2 and 6.
3. Other conditions precedent (if any):

Failure to comply with these conditions within the time specified will entitle Owner to consider you in default, annul this Notice of Award, and declare your Bid security forfeited.

Within 10 days after you comply with the above conditions, Owner will return to you one fully signed counterpart of the Agreement, together with any additional copies of the Contract Documents as indicated in Paragraph 2.02 of the General Conditions.

Owner: **Calaveras County Water District**

By (*signature*): \_\_\_\_\_

Name  
(*printed*): \_\_\_\_\_

Title: \_\_\_\_\_

Copy: Engineer

CIP 15095  
Arnold WWTF Phase I Improvements Project

00510-1

Notice of Award  
June 2025

**EJCDC® C-510, Notice of Award.**

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# AGREEMENT BETWEEN OWNER AND CONTRACTOR FOR CONSTRUCTION CONTRACT

This Agreement is by and between **Calaveras County Water District** (“Owner”) and \_\_\_\_\_ (“Contractor”).

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

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: The Project will replace all of existing conventional manual, direct read water meters with radio read meters along with constructing a fixed network of data collectors to automatically read the new water meters.

## ARTICLE 2—THE PROJECT

2.01 The Project, of which the Work under the Contract Documents is a part, is generally described as follows: Arnold WWTF Phase I Improvements Project

## ARTICLE 3—ENGINEER

3.01 The Owner has retained **Kevin Williams, P.E., District Engineer** (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.

3.02 The part of the Project that pertains to the Work has been designed by Calaveras County Water District.

## ARTICLE 4—CONTRACT TIMES

4.01 *Time is 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 complete within **660 calendar days** 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 **700 calendar days** days after the date when the Contract Times commence to run.

#### 4.05 *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 and Milestones not achieved within the Contract Times, as duly modified. 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 **\$1,200** for each day that expires after the time (as duly adjusted pursuant to the Contract) specified 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 Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner **\$750** 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.
- B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.
- C. Deleted

#### **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 the 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 the basis of Contractor's Applications for Payment on or about the 15<sup>th</sup> 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.

- 6.02.A.1. a. 95 percent of Work completed (with the balance being retainage).
- b. 95 percent of cost of materials and equipment not incorporated into the Work (with the balance being retainage).

- B. Upon Substantial Completion of the entire construction to be provided under the construction Contract Documents, Owner shall pay an amount sufficient to increase total payments to Contractor to **95** percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less **100** 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, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.

#### 6.04 *Consent of Surety*

- A. Owner will not make final payment, or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.

### **ARTICLE 7—CONTRACT DOCUMENTS**

#### 7.01 *Contents*

- A. The Contract Documents consist of all of the following:
  - 1. This Agreement.
  - 2. Bonds:
    - a. Performance bond (together with power of attorney).
    - b. Payment bond (together with power of attorney).
  - 3. General Conditions.
  - 4. Supplementary Conditions.
  - 5. USDA Rural Development Supplementary Conditions
  - 6. Specifications as listed in the table of contents of the project manual (copy of list attached).
  - 7. Drawings listed on the attached sheet index.
  - 8. Addenda
  - 9. Exhibits to this Agreement (enumerated as follows):
    - a. Contractor's bid

- b. Documentation submitted by the Contractor prior to Notice of Award including Insurance Endorsements.
- 10. 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.
  - e. Warranty Bond, if any.
- B. The Contract Documents listed in Paragraph 7.01.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 7.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.

## **ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS**

### **8.01 Contractor's Representations**

- A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
  - 1. Contractor has examined and carefully studied the Contract Documents, including Addenda.
  - 2. Contractor has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
  - 3. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
  - 4. Contractor has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
  - 5. Contractor has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
  - 6. 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 Technical Data identified in the Supplementary Conditions or by definition, with respect to the

effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.

7. 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.
8. 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.
9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. 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.

#### 8.02 *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 8.02:
  1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything 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.

#### 8.03 *Standard General Conditions*

- A. Owner stipulates that if the General Conditions that are made a part of this Contract are EJCDC® C-700, Standard General Conditions for the Construction Contract (2018), 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:

CALAVERAS COUNTY WATER DISTRICT

*(typed or printed name of organization)*

By:

*(individual's signature)*

Date:

*(date signed)*

Name: Michael J. Minkler

*(typed or printed)*

Title: General Manager

*(typed or printed)*

Attest:

*(individual's signature)*

Title: Executive Assistant/Clerk to the Board

*(typed or printed)*

Address for giving notices:

Calaveras County Water District

120 Toma Court

San Andreas, CA 95249

Designated Representative:

Name:

*(typed or printed)*

Title:

*(typed or printed)*

Address:

Calaveras County Water District

120 Toma Court

San Andreas, CA 95249

Phone:

Email:

Contractor:

*(typed or printed name of organization)*

By:

*(individual's signature)*

Date:

*(date signed)*

Name:

*(typed or printed)*

Title:

*(typed or printed)*

*(If [Type of Entity] is a corporation, a partnership, or a joint venture, attach evidence of authority to sign.)*

Attest:

*(individual's signature)*

Title:

*(typed or printed)*

Address for giving notices:

Designated Representative:

Name:

*(typed or printed)*

Title:

*(typed or printed)*

Address:

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

License No.: \_\_\_\_\_  
\_\_\_\_\_  
(where applicable)  
State: \_\_\_\_\_

**CERTIFICATE OF OWNER’S ATTORNEY**

This attachment is to the Contract made and entered into on \_\_\_\_\_, by and between the **Calaveras County Water District** hereinafter “Owner”, and \_\_\_\_\_ hereinafter called “Contractor.” This Contract is for that Work described in the Contract Documents entitled Arnold WWTF Phase I Improvements Project.

**CERTIFICATE OF OWNER’S ATTORNEY**

I, the undersigned, \_\_\_\_\_, the duly authorized and

acting legal representative of \_\_\_\_\_, do hereby certify as follows:

I have examined the attached Contract(s) and performance and payment bond(s) and the manner of execution thereof, and I am of the opinion that each of the aforesaid agreements is adequate and has been duly executed by the proper parties thereto acting through their duly authorized representatives; that said representatives have full power and authority to execute said agreements on behalf of the respective parties named thereon; and that the foregoing agreements constitute valid and legally binding obligations upon the parties executing the same in accordance with terms, conditions, and provisions thereof. I also am of the opinion that the Contractor’s insurance coverage(s) complies with the requirements of the Contract.

\_\_\_\_\_  
(Attorney’s Signature) Date

## AGENCY CONCURRENCE

OWNER Name: \_\_\_\_\_

CONTRACTOR Name: \_\_\_\_\_

CONTRACT Date: \_\_\_\_\_

This CONTRACT shall not be effective for USDA funding unless and until concurred with by a delegated representative of USDA Rural Development in accordance with the Letter of Conditions for this project.

As lender and/or grantor of funds to OWNER to defray the costs of this CONTRACT, and not a party to this contract and without liability for any payments thereunder, USDA Rural Development hereby concurs in the form, content, and execution of this CONTRACT.

**United States Department of Agriculture**

**Rural Development**

\_\_\_\_\_  
Name Date

\_\_\_\_\_  
Title

# NOTICE TO PROCEED

Owner: Calaveras County Water District Owner's Project No.: 15095  
Engineer: HydroScience Engineers, Inc.  
Contractor: \_\_\_\_\_ Contractor's Project No.: \_\_\_\_\_  
Project: Arnold WWTF Phase I Improvements  
Contract Name: \_\_\_\_\_  
Effective Date of Contract: \_\_\_\_\_

Owner hereby notifies Contractor that the Contract Times under the above Contract will commence to run on \_\_\_\_\_ pursuant to Paragraph 4.01 of the General Conditions.

On that date, Contractor shall start performing its obligations under the Contract Documents. No Work will be done at the Site prior to such date.

In accordance with the Agreement:

The number of days to achieve Substantial Completion is **660 Calendar Days** from the date stated above for the commencement of the Contract Times, resulting in a date for Substantial Completion of \_\_\_\_\_; and the number of days to achieve readiness for final payment is **700 Calendar Days** from the commencement date of the Contract Times, resulting in a date for readiness for final payment of \_\_\_\_\_.

Before starting any Work at the Site, Contractor must comply with the following:

\_\_\_\_\_.

Owner: Calaveras County Water District  
By (signature): \_\_\_\_\_  
Name (printed): \_\_\_\_\_  
Title: \_\_\_\_\_  
Date Issued: \_\_\_\_\_  
Copy: Engineer

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## PERFORMANCE BOND

<p><b>Contractor</b></p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>	<p><b>Surety</b></p> <p>Name: _____</p> <p>Address <i>(principal place of business)</i>: _____</p>
<p><b>Owner</b></p> <p>Name: <b>Calaveras County Water District</b></p> <p>Mailing address <i>(principal place of business)</i>:  <b>120 Toma Court</b>  <b>San Andreas, CA 95249</b></p>	<p><b>Contract</b></p> <p>Description <i>(name and location)</i>:  <b>Arnold WWTF Phase I Improvements Project,  Calaveras County, California</b></p> <p>Contract Price: _____</p> <p>Effective Date of Contract: _____</p>
<p><b>Bond</b></p> <p>Bond Amount: _____</p> <p>Date of Bond: _____  <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form:  <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 16</p>	
<p>Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Performance Bond, do each cause this Performance Bond to be duly executed by an authorized officer, agent, or representative.</p>	
Contractor as Principal	Surety
_____ <i>(Full formal name of Contractor)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<p><i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i></p>	

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 will 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 may 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 will 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 does 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 does 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 will not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety will 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 will not be reduced or set off on account of any such unrelated obligations. No right of action will 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 must be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and must 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 will be applicable.
12. Notice to the Surety, the Owner, or the Contractor must 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 will be deemed deleted therefrom and provisions conforming to such

statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will 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 will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
16. Modifications to this Bond are as follows: None.

## PAYMENT BOND

<p><b>Contractor</b></p> <p>Name: _____</p> <p>Address (<i>principal place of business</i>): _____</p>	<p><b>Surety</b></p> <p>Name: _____</p> <p>Address (<i>principal place of business</i>): _____</p>
<p><b>Owner</b></p> <p>Name: <b>Calaveras County Water District</b></p> <p>Mailing address (<i>principal place of business</i>):  <b>120 Toma Court</b>  <b>San Andreas, CA 95249</b></p>	<p><b>Contract</b></p> <p>Description (<i>name and location</i>):  <b>Arnold WWTF Phase I Improvements Project</b></p> <p>Contract Price: _____</p> <p>Effective Date of Contract: _____</p>
<p><b>Bond</b></p> <p>Bond Amount: _____</p> <p>Date of Bond: _____  <i>(Date of Bond cannot be earlier than Effective Date of Contract)</i></p> <p>Modifications to this Bond form:  <input type="checkbox"/> None <input type="checkbox"/> See Paragraph 18</p>	
<p>Surety and Contractor, intending to be legally bound hereby, subject to the terms set forth in this Payment Bond, do each cause this Payment Bond to be duly executed by an authorized officer, agent, or representative.</p>	
Contractor as Principal	Surety
_____ <i>(Full formal name of Contractor)</i>	_____ <i>(Full formal name of Surety) (corporate seal)</i>
By: _____ <i>(Signature)</i>	By: _____ <i>(Signature)(Attach Power of Attorney)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
Attest: _____ <i>(Signature)</i>	Attest: _____ <i>(Signature)</i>
Name: _____ <i>(Printed or typed)</i>	Name: _____ <i>(Printed or typed)</i>
Title: _____	Title: _____
<p><i>Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party is considered plural where applicable.</i></p>	

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 will 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 will 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 will 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 will 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 will 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 will 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 satisfying 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 will 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 will be applicable.
13. Notice and Claims to the Surety, the Owner, or the Contractor must be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, will 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 will be deemed deleted here from and provisions conforming to such statutory or other legal requirement will be deemed incorporated herein. When so furnished, the intent is that this Bond will 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:

16.1.1. The name of the Claimant;

16.1.2. The name of the person for whom the labor was done, or materials or equipment furnished;

- 16.1.3. 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;
  - 16.1.4. A brief description of the labor, materials, or equipment furnished;
  - 16.1.5. The date on which the Claimant last performed labor or last furnished materials or equipment for use in the performance of the Construction Contract;
  - 16.1.6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
  - 16.1.7. The total amount of previous payments received by the Claimant; and
  - 16.1.8. The total amount due and unpaid to the Claimant for labor, materials, or equipment furnished as of the date of the Claim.
- 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 is 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.
17. If this Bond is issued for an agreement between a contractor and subcontractor, the term Contractor in this Bond will be deemed to be Subcontractor and the term Owner will be deemed to be Contractor.
18. Modifications to this Bond are as follows: None.

**Contractor's Application for Payment**

<b>Owner:</b> <u>Calaveras County Water District</u>	<b>Owner's Project No.:</b> <u>15095</u>
<b>Engineer:</b> <u>HydroScience Engineers</u>	<b>Engineer's Project No.:</b> _____
<b>Contractor:</b> _____	<b>Contractor's Project No.:</b> _____
<b>Project:</b> <u>Arnold WWTF Phase I Improvements Project</u>	
<b>Contract:</b> _____	
<b>Application No.:</b> _____	<b>Application Date:</b> _____
<b>Application Period:</b> <b>From</b> _____ <b>to</b> _____	

1. Original Contract Price	\$	-
2. Net change by Change Orders	\$	-
3. Current Contract Price (Line 1 + Line 2)	\$	-
4. Total Work completed and materials stored to date (Sum of Column G Lump Sum Total and Column J Unit Price Total)	\$	-
5. Retainage		
a. _____ X \$ - Work Completed	\$	-
b. _____ X \$ - Stored Materials	\$	-
c. Total Retainage (Line 5.a + Line 5.b)	\$	-
6. Amount eligible to date (Line 4 - Line 5.c)	\$	-
7. Less previous payments (Line 6 from prior application)		
8. Amount due this application	\$	-
9. Balance to finish, including retainage (Line 3 - Line 4)	\$	-

**Contractor's Certification**

The undersigned Contractor certifies, to the best of its knowledge, the following:

(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;

(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such liens, security interest, or encumbrances); and

(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

**Contractor:** \_\_\_\_\_

**Signature:** \_\_\_\_\_ **Date:** \_\_\_\_\_

<b>Recommended by Engineer</b>	<b>Approved by Owner</b>
<b>By:</b> _____	<b>By:</b> _____
<b>Title:</b> _____	<b>Title:</b> _____
<b>Date:</b> _____	<b>Date:</b> _____
<b>Approved by Funding Agency</b>	
<b>By:</b> _____	<b>By:</b> _____
<b>Title:</b> _____	<b>Title:</b> _____
<b>Date:</b> _____	<b>Date:</b> _____

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# CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: Calaveras County Water District  
Engineer: HydroScience Engineers  
Contractor:  
Project: Arnold WWTF Phase I Improvements Project  
Contract Name:

Owner's Project No.: 15095

Contractor's Project No.:

This  Preliminary  Final Certificate of Substantial Completion applies to:

All Work  The following specified portions of the Work:

\_\_\_\_\_.

Date of Substantial Completion: \_\_\_\_\_

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see Paragraph 15.03.D of the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities:  None  As follows:

\_\_\_\_\_.

Amendments to Contractor's Responsibilities:  None  As follows:

\_\_\_\_\_.

The following documents are attached to and made a part of this Certificate:

\_\_\_\_\_.

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By (*signature*): \_\_\_\_\_

Name (*printed*): \_\_\_\_\_

Title: \_\_\_\_\_

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# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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# STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

## 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 document prepared by Contractor, in a form acceptable to Engineer, to request 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; 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; 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.
- 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.
  - c. A demand or assertion by Owner or Contractor, duly submitted in compliance with the procedural requirements set forth herein, made pursuant to Paragraph 12.01.A.4, concerning disputes arising after Engineer has issued a recommendation of final payment.
  - d. 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), lead-based paint (as defined by the HUD/EPA standard), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to Laws and Regulations 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 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. *Electronic Document*—Any Project-related correspondence, attachments to correspondence, data, documents, drawings, information, or graphics, including but not limited to Shop Drawings and other Submittals, that are in an electronic or digital format.
21. *Electronic Means*—Electronic mail (email), upload/download from a secure Project website, or other communications methods that allow: (a) the transmission or communication of Electronic Documents; (b) the documentation of transmissions,

including sending and receipt; (c) printing of the transmitted Electronic Document by the recipient; (d) the storage and archiving of the Electronic Document by sender and recipient; and (e) the use by recipient of the Electronic Document for purposes permitted by this Contract. Electronic Means does not include the use of text messaging, or of Facebook, Twitter, Instagram, or similar social media services for transmission of Electronic Documents.

22. *Engineer*—The individual or entity named as such in the Agreement.
23. *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.
24. *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.
  - a. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated into the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, is not a Hazardous Environmental Condition.
  - b. The presence of Constituents of Concern that are to be removed or remediated as part of the Work is not a Hazardous Environmental Condition.
  - c. The presence of Constituents of Concern as part of the routine, anticipated, and obvious working conditions at the Site, is not a Hazardous Environmental Condition.
25. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and binding decrees, resolutions, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
26. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
27. *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.
28. *Notice of Award*—The written notice by Owner to a Bidder of Owner’s acceptance of the Bid.
29. *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.
30. *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.
31. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising Contractor’s plan to accomplish the Work within the Contract Times.

32. *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.
33. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative (RPR) includes any assistants or field staff of Resident Project Representative.
34. *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.
35. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer’s review of the submittals.
36. *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.
37. *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.
38. *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 or areas furnished by Owner which are designated for the use of Contractor.
39. *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.
40. *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.
41. *Submittal*—A written or graphic document, prepared by or for Contractor, which the Contract Documents require Contractor to submit to Engineer, or that is indicated as a Submittal in the Schedule of Submittals accepted by Engineer. Submittals may include Shop Drawings and Samples; schedules; product data; Owner-delegated designs; sustainable design information; information on special procedures; testing plans; results of tests and evaluations, source quality-control testing and inspections, and field or Site quality-control testing and inspections; warranties and certifications; Suppliers’ instructions and reports; records of delivery of spare parts and tools; operations and maintenance data; Project photographic documentation; record documents; and other such documents required by the Contract Documents. Submittals, whether or not approved or accepted by Engineer, are not Contract Documents. Change Proposals, Change Orders, Claims, notices, Applications for Payment, and requests for interpretation or clarification are not Submittals.
42. *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 of such Work.

43. *Successful Bidder*—The Bidder to which the Owner makes an award of contract.
44. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
45. *Supplier*—A manufacturer, fabricator, supplier, distributor, 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.
46. *Technical Data*
  - a. Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (1) existing subsurface conditions at or adjacent to the Site, or existing physical conditions at or adjacent to the Site including existing surface or subsurface structures (except Underground Facilities) or (2) Hazardous Environmental Conditions at the Site.
  - b. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then Technical Data is defined, with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06, as the data contained in boring logs, recorded measurements of subsurface water levels, assessments of the condition of subsurface facilities, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical, environmental, or other Site or facilities conditions report prepared for the Project and made available to Contractor.
  - c. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data, and instead Underground Facilities are shown or indicated on the Drawings.
47. *Underground Facilities*—All active or not-in-service underground lines, pipelines, conduits, ducts, encasements, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or systems at the Site, including but not limited to those facilities or systems that produce, transmit, distribute, or convey telephone or other communications, cable television, fiber optic transmissions, power, electricity, light, heat, gases, oil, crude oil products, liquid petroleum products, water, steam, waste, wastewater, storm water, other liquids or chemicals, or traffic or other control systems. An abandoned facility or system is not an Underground Facility.
48. *Unit Price Work*—Work to be paid for on the basis of unit prices.
49. *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.

50. *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 Paragraphs 1.02.B, C, D, and E are not defined terms that require initial capital letters, but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.
- B. *Intent of Certain Terms or Adjectives*: 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*: The word “day” means a calendar day of 24 hours measured from midnight to the next midnight.
- D. *Defective*: The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
1. does not conform to the Contract Documents;
  2. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
  3. 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 Paragraph 15.04).
- E. *Furnish, Install, Perform, Provide*
1. The word “furnish,” when used in connection with services, materials, or equipment, means 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, means 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, means 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. *Contract Price or Contract Times*: References to a change in “Contract Price or Contract Times” or “Contract Times or Contract Price” or similar, indicate that such change applies to (1) Contract Price, (2) Contract Times, or (3) both Contract Price and Contract Times, as warranted, even if the term “or both” is not expressed.
- G. 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 Performance and Payment Bonds; Evidence of Insurance***

- A. *Performance and Payment Bonds*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner the performance bond and payment bond (if the Contract requires Contractor to furnish such bonds).
- B. *Evidence of Contractor’s Insurance*: When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner, with copies to each additional insured (as identified in the Contract), the certificates, endorsements, and other evidence of insurance required to be provided by Contractor in accordance with Article 6, except to the extent the Supplementary Conditions expressly establish other dates for delivery of specific insurance policies.
- C. *Evidence of Owner’s Insurance*: After receipt of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor, with copies to each additional insured (as identified in the Contract), 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 signed 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 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 *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 the schedules submitted in accordance with Paragraph 2.03.A. No progress payment will 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.
  4. If a schedule is not acceptable, Contractor will have an additional 10 days to revise and resubmit the schedule.

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may send, and shall accept, Electronic Documents transmitted by Electronic Means.
- B. If the Contract does not establish protocols for Electronic Means, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. Subject to any governing protocols for Electronic Means, when transmitting Electronic Documents by Electronic Means, the transmitting party makes no representations as to long-term compatibility, usability, or readability of the Electronic Documents 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 Electronic Documents.

**ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE**

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one Contract Document 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 versions of the Contract Documents (including any printed copies derived from such electronic versions) and the printed record version, the printed record version will 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.
- F. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation will be deemed stricken, and all remaining provisions will continue to be valid and binding upon Owner and Contractor, which agree that the Contract Documents will 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.
- G. Nothing in the Contract Documents creates:
  - 1. any contractual relationship between Owner or Engineer and any Subcontractor, Supplier, or other individual or entity performing or furnishing any of the Work, for the benefit of such Subcontractor, Supplier, or other individual or entity; or
  - 2. 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.

### 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, means 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, and no instruction of a Supplier, will be effective to change the duties or responsibilities of Owner, Contractor, or Engineer 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 or Engineer 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 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 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 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 in writing 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.
- 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 notify Owner and Contractor in writing 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 versions, 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 precludes 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 30th 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 60th day after the day of Bid opening or the 30th 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 may 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 must 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 will 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 Contract Price or 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. Such an adjustment will 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 third-party utility owners or other third-party entities (other than those third-party utility owners or other third-party entities performing other work at or adjacent to the Site as arranged by or under contract with Owner, as contemplated in Article 8); and
  4. Acts of war or terrorism.
- D. Contractor's entitlement to an adjustment of Contract Times or Contract Price is limited as follows:
1. Contractor's entitlement to an adjustment of the Contract Times is conditioned on the delay, disruption, or interference adversely affecting an activity on the critical path to completion of the Work, as of the time of the delay, disruption, or interference.
  2. Contractor shall not be entitled to an adjustment in Contract Price 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. Such a concurrent delay by Contractor shall not preclude an adjustment of Contract Times to which Contractor is otherwise entitled.
  3. Adjustments of Contract Times or Contract Price are subject to the provisions of Article 11.
- E. Each Contractor request or Change Proposal seeking an increase in Contract Times or Contract Price must be supplemented by supporting data that sets forth in detail the following:
1. The circumstances that form the basis for the requested adjustment;
  2. The date upon which each cause of delay, disruption, or interference began to affect the progress of the Work;
  3. The date upon which each cause of delay, disruption, or interference ceased to affect the progress of the Work;
  4. The number of days' increase in Contract Times claimed as a consequence of each such cause of delay, disruption, or interference; and
  5. The impact on Contract Price, in accordance with the provisions of Paragraph 11.07.

Contractor shall also furnish such additional supporting documentation as Owner or Engineer may require including, where appropriate, a revised progress schedule indicating all the activities affected by the delay, disruption, or interference, and an explanation of the effect of the delay, disruption, or interference on the critical path to completion of the Work.

- F. 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, together with the provisions of Paragraphs 4.05.D and 4.05.E.
- G. Paragraph 8.03 addresses 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.

## **ARTICLE 5—SITE; SUBSURFACE AND PHYSICAL CONDITIONS; HAZARDOUS ENVIRONMENTAL CONDITIONS**

### **5.01 *Availability of Lands***

- A. Owner shall furnish the Site. Owner shall notify Contractor in writing 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, or to improvements, structures, utilities, or similar facilities located at such adjacent lands 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 7.13, 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 in a court of competent jurisdiction; 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 will 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 of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data;
  - 2. Those drawings of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data; and
  - 3. Technical Data contained in such reports and drawings.
- B. *Underground Facilities:* Underground Facilities are shown or indicated on the Drawings, pursuant to Paragraph 5.05, and not in the drawings referred to in Paragraph 5.03.A. Information and data regarding the presence or location of Underground Facilities are not intended to be categorized, identified, or defined as Technical Data.
- C. *Reliance by Contractor on Technical Data:* 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 Paragraph 1.01.A.46.b.

- D. *Limitations of Other Data and Documents:* 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;
  2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings;
  3. the contents of other Site-related documents made available to Contractor, such as record drawings from other projects at or adjacent to the Site, or Owner's archival documents concerning the Site; or
  4. 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:
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;
  2. is of such a nature as to require a change in the Drawings or Specifications;
  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 whether it is necessary for Owner to obtain 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; 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. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the subsurface or physical condition in question may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the condition in question has been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- E. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, 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 subject to the provisions of Paragraphs 4.05.D and 4.05.E.
  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;
    - 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 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, then any such adjustment will 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, 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.

- F. *Underground Facilities; Hazardous Environmental Conditions*: Paragraph 5.05 governs rights and responsibilities regarding the presence or location of Underground Facilities. Paragraph 5.06 governs rights and responsibilities regarding Hazardous Environmental Conditions. The provisions of Paragraphs 5.03 and 5.04 are not applicable to the presence or location of Underground Facilities, or to Hazardous Environmental Conditions.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities*: Unless it is otherwise expressly provided in the Supplementary Conditions, the cost of all of the following are included in the Contract Price, and Contractor shall have full responsibility for:
1. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
  2. complying with applicable state and local utility damage prevention Laws and Regulations;
  3. verifying the actual location of those Underground Facilities shown or indicated in the Contract Documents as being within the area affected by the Work, by exposing such Underground Facilities during the course of construction;
  4. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
  5. 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 on the Drawings, or was not shown or indicated on the Drawings 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), notify Owner and Engineer in writing regarding such Underground Facility.
- C. *Engineer's Review*: Engineer will:
1. promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated on the Drawings, or was not shown or indicated with reasonable accuracy;
  2. identify and communicate with the owner of the Underground Facility; prepare recommendations to Owner (and if necessary issue any preliminary instructions to Contractor) regarding the Contractor's resumption of Work in connection with the Underground Facility in question;
  3. obtain any pertinent cost or schedule information from Contractor; 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
  4. 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. *Early Resumption of Work:* If at any time Engineer determines that Work in connection with the Underground Facility may resume prior to completion of Engineer's review or Owner's issuance of its statement to Contractor, because the Underground Facility in question and conditions affected by its presence have been adequately documented, and analyzed on a preliminary basis, then the Engineer may at its discretion instruct Contractor to resume such Work.
- F. *Possible Price and Times Adjustments*
1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, to the extent that any existing Underground Facility at the Site that was not shown or indicated on the Drawings, 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. 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;
    - b. Contractor's entitlement to an adjustment of the Contract Times is subject to the provisions of Paragraphs 4.05.D and 4.05.E; and
    - c. 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, then any such adjustment will 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, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.
  4. The information and data shown or indicated on the Drawings with respect to existing Underground Facilities at the Site is based on information and data (a) furnished by the owners of such Underground Facilities, or by others, (b) obtained from available records, or (c) gathered in an investigation conducted in accordance with the current edition of ASCE 38, Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, by the American Society of Civil Engineers. If such information or data is incorrect or incomplete, Contractor's remedies are limited to those set forth in this Paragraph 5.05.F.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
1. those reports known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site;
  2. drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; 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 on the accuracy of the Technical Data as defined in Paragraph 1.01.A.46.b. 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;
  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, as a result of such Work stoppage, such special conditions under which Work is agreed to be resumed by Contractor, or any costs or expenses incurred in response to the Hazardous Environmental Condition, 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. Entitlement to any such adjustment is subject to the provisions of Paragraphs 4.05.D, 4.05.E, 11.07, and 11.08.
- 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, 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.I obligates 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 obligates 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 Contractor's obligations under the Contract. These bonds must 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 terms of a prescribed bond form, the Supplementary Conditions, or other provisions of the Contract.
- B. Contractor shall also furnish such other bonds (if any) as are required by the Supplementary Conditions or other provisions of the Contract.
- C. All bonds must be in the form included in the Bidding Documents or otherwise specified by Owner prior to execution of the Contract, except as provided otherwise by Laws or Regulations, and must be issued and signed by a surety named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Department Circular 570 (as amended and supplemented) by the Bureau of the Fiscal Service, 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 must show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- D. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue bonds in the required amounts.
- E. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer in writing and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which must comply with the bond and surety requirements above.
- F. 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.
- G. Upon request to Owner from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Owner shall provide a copy of the payment bond to such person or entity.
- H. Upon request to Contractor from any Subcontractor, Supplier, or other person or entity claiming to have furnished labor, services, materials, or equipment used in the performance of the Work, Contractor shall provide a copy of the payment bond to such person or entity.

## 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. Alternative forms of insurance coverage, including but not limited to self-insurance and “Occupational Accident and Excess Employer’s Indemnity Policies,” are not sufficient to meet the insurance requirements of this Contract, unless expressly allowed in the Supplementary Conditions.
- D. Contractor shall deliver to Owner, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Contractor has obtained and is maintaining the policies and coverages 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, documentation of applicable self-insured retentions (if allowed) and deductibles, full disclosure of all relevant exclusions, and evidence of insurance required to be purchased and maintained by Subcontractors or Suppliers. In any documentation furnished under this provision, Contractor, Subcontractors, and Suppliers may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those applicable to this Contract.
- E. Owner shall deliver to Contractor, with copies to each additional insured identified in the Contract, certificates of insurance and endorsements establishing that Owner has obtained and is maintaining the policies and coverages 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, documentation of applicable self-insured retentions (if allowed) and deductibles, and full disclosure of all relevant exclusions. In any documentation furnished under this provision, Owner may block out (redact) (1) any confidential premium or pricing information and (2) any wording specific to a project or jurisdiction other than those relevant to this Contract.
- F. 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, will not be construed as a waiver of the other party’s obligation to obtain and maintain such insurance.
- G. In addition to the liability insurance required to be provided by Contractor, the Owner, at Owner’s option, may purchase and maintain Owner’s own liability insurance. 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.

- H. Contractor shall require:
1. Subcontractors to purchase and maintain worker's compensation, commercial general liability, and other insurance that is appropriate for their participation in the Project, and to name as additional insureds Owner and Engineer (and any other individuals or entities identified in the Supplementary Conditions as additional insureds on Contractor's liability policies) on each Subcontractor's commercial general liability insurance policy; and
  2. Suppliers to purchase and maintain insurance that is appropriate for their participation in the Project.
- I. If either party does not purchase or maintain 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.
- J. If Contractor has failed to obtain and maintain required insurance, Contractor's entitlement to enter or remain at the Site will end immediately, and Owner may impose an appropriate set-off against payment for any associated costs (including but not limited to the cost of purchasing necessary insurance coverage), and exercise Owner's termination rights under Article 16.
- K. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect (but is in no way obligated) 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 will be adjusted accordingly.
- L. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests. Contractor is responsible for determining whether such coverage and limits are adequate to protect its interests, and for obtaining and maintaining any additional insurance that Contractor deems necessary.
- M. The insurance and insurance limits required herein will not be deemed as a limitation on Contractor's liability, or that of its Subcontractors or Suppliers, under the indemnities granted to Owner and other individuals and entities in the Contract or otherwise.
- N. All the policies of insurance required to be purchased and maintained under this Contract will contain a provision or endorsement that the coverage afforded will not be canceled, 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 and Engineer.

### 6.03 *Contractor's Insurance*

- A. *Required Insurance:* Contractor shall purchase and maintain Worker's Compensation, Commercial General Liability, and other insurance pursuant to the specific requirements of the Supplementary Conditions.
- B. *General Provisions:* The policies of insurance required by this Paragraph 6.03 as supplemented must:
1. include at least the specific coverages required;

2. be written for not less than the limits provided, or those required by Laws or Regulations, whichever is greater;
  3. remain in effect at least until the Work is complete (as set forth in Paragraph 15.06.D), and longer if expressly required elsewhere in this Contract, 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;
  4. apply with respect to the performance of the Work, whether such performance is 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; and
  5. include all necessary endorsements to support the stated requirements.
- C. *Additional Insureds*: The Contractor's commercial general liability, automobile liability, employer's liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies, if required by this Contract, must:
1. include and list as additional insureds Owner and Engineer, and any individuals or entities identified as additional insureds in the Supplementary Conditions;
  2. include coverage for the respective officers, directors, members, partners, employees, and consultants of all such additional insureds;
  3. afford primary coverage to these additional insureds for all claims covered thereby (including as applicable those arising from both ongoing and completed operations);
  4. not seek contribution from insurance maintained by the additional insured; and
  5. as to commercial general liability insurance, apply to additional insureds with respect to liability caused in whole or in part by Contractor's acts or omissions, or the acts and omissions of those working on Contractor's behalf, in the performance of Contractor's operations.

#### 6.04 *Builder's Risk and Other 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 Work's full insurable replacement cost (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). The specific requirements applicable to the builder's risk insurance are set forth in the Supplementary Conditions.
- B. *Property Insurance for Facilities of Owner Where Work Will Occur*: Owner is responsible for obtaining and maintaining property insurance covering each existing structure, building, or facility in which any part of the Work will occur, or to which any part of the Work will attach or be adjoined. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, providing coverage consistent with that required for the builder's risk insurance, and will be maintained until the Work is complete, as set forth in Paragraph 15.06.D.

- C. *Property Insurance for Substantially Complete Facilities:* Promptly after Substantial Completion, and before actual occupancy or use of the substantially completed Work, Owner will obtain property insurance for such substantially completed Work, and maintain such property insurance at least until the Work is complete, as set forth in Paragraph 15.06.D. Such property insurance will be written on a special perils (all-risk) form, on a replacement cost basis, and provide coverage consistent with that required for the builder's risk insurance. The builder's risk insurance may terminate upon written confirmation of Owner's procurement of such property insurance.
- 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 advance notice of such occupancy or use to the builder's risk insurer, and obtain an endorsement consenting to the continuation of coverage prior to commencing such partial occupancy or use.
- E. *Insurance of Other Property; Additional Insurance:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, then the entity or individual owning such property item will be responsible for insuring it. 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 6.04, it may do so at Contractor's expense.

#### 6.05 *Property Losses; Subrogation*

- A. The builder's risk insurance policy purchased and maintained in accordance with Paragraph 6.04 (or an installation floater policy if authorized by the Supplementary Conditions), will contain provisions to the effect that in the event of payment of any loss or damage the insurer 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.
  - 1. 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, risks, 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 individuals or entities identified in the Supplementary Conditions as builder's risk or installation floater 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.
  - 2. None of the above waivers extends 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. Any property insurance policy maintained by Owner covering any loss, damage, or consequential loss to Owner's existing structures, buildings, or facilities in which any part of the Work will occur, or to which any part of the Work will attach or adjoin; to adjacent structures, buildings, or facilities of Owner; or to part or all of the completed or substantially completed Work, 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, will contain provisions to the effect that in the event of payment of any loss or damage the insurer will have no rights of recovery against any insureds thereunder, or against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them, and that the insured is allowed to waive the insurer's rights of subrogation in a written contract executed prior to the loss, damage, or consequential loss.

1. 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 all losses and damages caused by, arising out of, or resulting from fire or any of the perils, risks, or causes of loss covered by such policies.
- C. The waivers in this Paragraph 6.05 include the waiver of rights 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 insured peril, risk, or cause of loss.
- D. Contractor shall be responsible for assuring that each Subcontract 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 fire or other peril, risk, or cause of loss covered by builder's risk insurance, installation floater, and any other property insurance applicable to the Work.

6.06 *Receipt and Application of Property Insurance Proceeds*

- A. Any insured loss under the builder's risk and other policies of property insurance required by Paragraph 6.04 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 6.04 shall maintain such proceeds in a segregated account, and 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, Contractor shall repair or replace the damaged Work, using allocated insurance proceeds.

## ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

### 7.01 *Contractor's Means and Methods of Construction*

- A. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction.
- B. If the Contract Documents note, or Contractor determines, that professional engineering or other design services are needed to carry out Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures, or for Site safety, then Contractor shall cause such services to be provided by a properly licensed design professional, at Contractor's expense. Such services are not Owner-delegated professional design services under this Contract, and neither Owner nor Engineer has any responsibility with respect to (1) Contractor's determination of the need for such services, (2) the qualifications or licensing of the design professionals retained or employed by Contractor, (3) the performance of such services, or (4) any errors, omissions, or defects in such services.

### 7.02 *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.
- B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who will not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

### 7.03 *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 maintain good discipline and order at the Site.
- B. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of Contractor's employees; of Suppliers and Subcontractors, and their employees; and of any other individuals or entities performing or furnishing any of the Work, just as Contractor is responsible for Contractor's own acts and omissions.
- C. 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 will 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.

### 7.04 *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 must be new and of good quality, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications will 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 must 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.

7.05 *“Or Equals”*

- A. *Contractor’s Request; Governing Criteria:* Whenever an item of equipment or material is specified or described in the Contract Documents by using the names of one or more proprietary items or specific Suppliers, 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 equipment or material, or items from other proposed Suppliers, under the circumstances described below.
  - 1. If Engineer in its sole discretion determines that an item of equipment or material proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer will deem it an “or equal” item. For the purposes of this paragraph, a proposed item of equipment or material will be considered functionally equal to an item so named if:
    - a. in the exercise of reasonable judgment Engineer determines that the proposed item:
      - 1) is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
      - 2) 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) has a proven record of performance and availability of responsive service; and
      - 4) is not objectionable to Owner.
    - b. Contractor certifies that, if the proposed item is approved and incorporated into the Work:
      - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
      - 2) the item 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 will result in any change in Contract Price. The Engineer’s denial of an “or-equal” request will be final and binding, and may not be reversed through an appeal under any provision of the Contract.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of equipment or material proposed by Contractor does not qualify as an “or-equal” item, Contractor may request that Engineer consider the item a proposed substitute pursuant to Paragraph 7.06.

#### 7.06 *Substitutes*

- A. *Contractor’s Request; Governing Criteria:* Unless the specification or description of an item of equipment or material 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 equipment or material under the circumstances described below. To the extent possible such requests must 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 equipment or material from anyone other than Contractor.
  - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.06.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 equipment or material that Contractor seeks to furnish or use. The application:
    - a. will 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 the item specified; and
      - 3) be suited to the same use as the item 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 the item specified; and
    - 2) available engineering, sales, maintenance, repair, and replacement services.
  - d. will 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 will be final and binding, and may not be reversed through an appeal under any provision of the Contract. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.06.D, by timely submittal of a Change Proposal.

#### 7.07 Concerning Subcontractors and Suppliers

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner. The Contractor's retention of a Subcontractor or Supplier for the performance of parts of the Work will not relieve Contractor's obligation to Owner to perform and complete the Work in accordance with the Contract Documents.

- B. Contractor shall retain specific Subcontractors and Suppliers 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 or Supplier 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 5 days.
- E. Owner may require the replacement of any Subcontractor or Supplier. 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 or Suppliers 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 or Supplier so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor or Supplier.
- F. If Owner requires the replacement of any Subcontractor or Supplier retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, 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 or Supplier, whether initially or as a replacement, will 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 solely responsible for scheduling and coordinating the work of Subcontractors and Suppliers.
- J. The divisions and sections of the Specifications and the identifications of any Drawings do not control Contractor in dividing the Work among Subcontractors or Suppliers, or in delineating the Work to be performed by any specific trade.
- K. All Work performed for Contractor by a Subcontractor or Supplier must be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract for the benefit of Owner and Engineer.
- L. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor for Work performed for Contractor by the Subcontractor or Supplier.

- M. Contractor shall restrict all Subcontractors and Suppliers from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed in this Contract.

#### 7.08 *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 an 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 will be disclosed 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.

#### 7.09 *Permits*

- A. Unless otherwise provided in the Contract Documents, Contractor shall obtain and pay for all construction permits, licenses, and certificates of occupancy. 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.

#### 7.10 *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.

### 7.11 *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. 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 is not Contractor's responsibility to make certain that the Work described in the Contract Documents is in accordance with Laws and Regulations, but this does not relieve Contractor of its obligations under Paragraph 3.03.
- C. Owner or Contractor may give written 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 written notice Contractor may submit a Change Proposal, or Owner may initiate a Claim.

### 7.12 *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.

### 7.13 *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.
- B. Contractor shall designate a qualified and experienced safety representative whose duties and responsibilities are the prevention of Work-related accidents and the maintenance and supervision of safety precautions and programs.
- C. 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.
- D. All damage, injury, or loss to any property referred to in Paragraph 7.13.C.2 or 7.13.C.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).
  - E. 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.
  - F. Contractor shall notify Owner; the owners of adjacent property; the owners of Underground Facilities and other utilities (if the identity of such owners is known to Contractor); and other contractors and utility owners performing work at or adjacent to the Site, in writing, when Contractor knows that 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.
  - G. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. Any Owner's safety programs that are applicable to the Work are identified or included in the Supplementary Conditions or Specifications.
  - H. 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.
  - I. Contractor's duties and responsibilities for safety and protection will continue until all the Work is completed, Engineer has issued a written notice to Owner and Contractor in accordance with Paragraph 15.06.C that the Work is acceptable, and Contractor has left the Site (except as otherwise expressly provided in connection with Substantial Completion).
  - J. Contractor's duties and responsibilities for safety and protection will 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.

#### 7.14 *Hazard Communication Programs*

- A. Contractor shall be responsible for coordinating any exchange of safety data sheets (formerly known as 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 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 by an emergency, or are required as a result of Contractor's response to an emergency. If Engineer determines that a change in the Contract Documents is required because of an emergency or Contractor's response, a Work Change Directive or Change Order will be issued.

## 7.16 *Submittals*

### A. *Shop Drawing and Sample Requirements*

1. Before submitting a Shop Drawing or Sample, Contractor shall:
  - a. review and coordinate the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
  - b. determine and verify:
    - 1) all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect to the Submittal;
    - 2) 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
    - 3) all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto;
  - c. confirm that the Submittal is complete with respect to all related data included in the Submittal.
2. Each Shop Drawing or Sample must 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 Shop Drawing or Sample, Contractor shall give Engineer specific written notice of any variations that the Submittal may have from the requirements of the Contract Documents. This notice must be set forth in a written communication separate from the Submittal; and, in addition, in the case of a Shop Drawing by a specific notation made on the Shop Drawing itself.

- B. *Submittal Procedures for Shop Drawings and Samples:* Contractor shall label and submit Shop Drawings and Samples to Engineer for review and approval in accordance with the accepted Schedule of Submittals.

### 1. *Shop Drawings*

- a. Contractor shall submit the number of copies required in the Specifications.

- b. Data shown on the Shop Drawings must 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.C.

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.C.
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. *Engineer's Review of Shop Drawings and Samples*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the accepted Schedule of Submittals. 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, comply with the requirements of 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 will 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 or other appropriate Contract modification.
5. Engineer's review and approval of a Shop Drawing or Sample will not relieve Contractor from responsibility for complying with the requirements of Paragraphs 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, will 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 or Sample will 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.C.4.

*D. Resubmittal Procedures for Shop Drawings and Samples*

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 Shop Drawing and Sample submittals with sufficient information and accuracy to obtain required approval of an item with no more than two resubmittals. Engineer will record Engineer's time for reviewing a third or subsequent resubmittal of a Shop Drawing or Sample, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges.
3. If Contractor requests a change of a previously approved Shop Drawing or Sample, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

*E. Submittals Other than Shop Drawings, Samples, and Owner-Delegated Designs*

1. The following provisions apply to all Submittals other than Shop Drawings, Samples, and Owner-delegated designs:
    - a. Contractor shall submit all such Submittals to the Engineer in accordance with the Schedule of Submittals and pursuant to the applicable terms of the Contract Documents.
    - b. Engineer will provide timely review of all such Submittals in accordance with the Schedule of Submittals and return such Submittals with a notation of either Accepted or Not Accepted. Any such Submittal that is not returned within the time established in the Schedule of Submittals will be deemed accepted.
    - c. Engineer's review will be only to determine if the Submittal is acceptable under the requirements of the Contract Documents as to general form and content of the Submittal.
    - d. If any such Submittal is not accepted, Contractor shall confer with Engineer regarding the reason for the non-acceptance, and resubmit an acceptable document.
  2. Procedures for the submittal and acceptance of the Progress Schedule, the Schedule of Submittals, and the Schedule of Values are set forth in Paragraphs 2.03, 2.04, and 2.05.
- F. Owner-delegated Designs: Submittals pursuant to Owner-delegated designs are governed by the provisions of Paragraph 7.19.

*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 is entitled to rely on Contractor's warranty and guarantee.

- B. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, Owner's rights under the correction period provisions of Paragraph 15.08. The time in which Owner may enforce its warranty and guarantee rights under this Paragraph 7.17 is limited only by applicable Laws and Regulations restricting actions to enforce such rights; provided, however, that after the end of the correction period under Paragraph 15.08:
1. Owner shall give Contractor written notice of any defective Work within 60 days of the discovery that such Work is defective; and
  2. Such notice will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the notice.
- C. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
1. abuse, or improper modification, 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.
- D. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents is absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents, a release of Contractor's obligation to perform the Work in accordance with the Contract Documents, or a release of Owner's warranty and guarantee rights under this Paragraph 7.17:
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. The end of the correction period established in Paragraph 15.08;
  8. Any inspection, test, or approval by others; or
  9. Any correction of defective Work by Owner.
- E. 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 will 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 losses,

damages, costs, and judgments (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 from third-party claims or actions relating to or resulting from the performance or furnishing of the Work, provided that any such claim, action, loss, cost, judgment or damage is attributable to bodily injury, sickness, disease, or death, or to damage 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 will 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.

#### 7.19 *Delegation of Professional Design Services*

- A. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Owner-delegated design.
- B. Contractor shall cause such Owner-delegated professional design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal must appear on all drawings, calculations, specifications, certifications, and Submittals prepared by such design professional. Such design professional must issue all certifications of design required by Laws and Regulations.
- C. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal must bear the written approval of Contractor's design professional when submitted by Contractor to Engineer.
- D. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under an Owner-delegated design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.
- E. Pursuant to this Paragraph 7.19, Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to an Owner-delegated design will be only for the following limited purposes:
  - 1. Checking for conformance with the requirements of this Paragraph 7.19;

2. Confirming that Contractor (through its design professionals) has used the performance and design criteria specified in the Contract Documents; and
  3. Establishing that the design furnished by Contractor is consistent with the design concept expressed in the Contract Documents.
- F. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
- G. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.

## **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 third-party utility work that Owner has arranged to take place at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford proper and safe access to the Site to each contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work.
- D. 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.
- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, 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.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay,

disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

#### 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 for Owner at or adjacent to the Site, the Owner's employees, any other contractor working for Owner, or any utility owner that Owner has arranged to perform work, 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. 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 will 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, and any remedies available to Contractor under Laws or Regulations concerning utility action or inaction. When applicable, any such equitable adjustment in Contract Price will 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 or Contract Price is subject to the provisions of Paragraphs 4.05.D and 4.05.E.
- 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.
  - 1. 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 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 8.03.B.

2. 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 Contractor.
- C. 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 will 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 (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 10.07. 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 *Resident 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 the Supplementary Conditions and in Paragraph 10.07.
- B. If Owner designates an individual or entity who is not Engineer's consultant, agent, or employee to represent Owner at the Site, then the responsibilities and authority of such individual or entity will be as provided in the Supplementary Conditions.

#### 10.04 *Engineer's Authority*

- A. Engineer has the authority to reject Work in accordance with Article 14.
- B. Engineer's authority as to Submittals is set forth in Paragraph 7.16.
- C. Engineer's authority as to design drawings, calculations, specifications, certifications and other Submittals from Contractor in response to Owner's delegation (if any) to Contractor of professional design services, is set forth in Paragraph 7.19.
- D. Engineer's authority as to changes in the Work is set forth in Article 11.
- E. Engineer's authority as to Applications for Payment is set forth in Article 15.

#### 10.05 *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.

#### 10.06 *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.

#### 10.07 *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, will 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 Contractor under 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 10.07 also apply to the Resident Project Representative, if any.

#### 10.08 *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 of which Engineer has been informed.

### **ARTICLE 11—CHANGES TO THE CONTRACT**

#### 11.01 *Amending and Supplementing the Contract*

- A. The Contract may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
- B. If an amendment or supplement to the Contract includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order.
- C. All changes to the Contract that 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, must be supported by Engineer's recommendation. Owner and Contractor may amend other terms and conditions of the Contract without the recommendation of the Engineer.

## 11.02 *Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
  - 1. Changes in 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 11.05, (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 that embody the substance of any final and binding results under: Paragraph 11.03.B, resolving the impact of a Work Change Directive; Paragraph 11.09, concerning Change Proposals; Article 12, Claims; Paragraph 13.02.D, final adjustments resulting from allowances; Paragraph 13.03.D, final adjustments relating to determination of quantities for Unit Price Work; and similar provisions.
- B. If Owner or Contractor refuses to execute a Change Order that is required to be executed under the terms of Paragraph 11.02.A, it will be deemed to be of full force and effect, as if fully executed.

## 11.03 *Work Change Directives*

- A. 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 11.07 regarding change of Contract Price.
- B. If Owner has issued a Work Change Directive and:
  - 1. Contractor believes that an adjustment in Contract Times or Contract Price is necessary, then Contractor shall submit any Change Proposal seeking such an adjustment no later than 30 days after the completion of the Work set out in the Work Change Directive.
  - 2. Owner believes that an adjustment in Contract Times or Contract Price is necessary, then Owner shall submit any Claim seeking such an adjustment no later than 60 days after issuance of the Work Change Directive.

## 11.04 *Field Orders*

- A. 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.

- B. If Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, then before proceeding with the Work at issue, Contractor shall submit a Change Proposal as provided herein.

#### 11.05 *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. Changes involving the design (as set forth in the Drawings, Specifications, or otherwise) or other engineering or technical matters will be supported by Engineer's recommendation.
- B. Such changes in the Work 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 must be performed under the applicable conditions of the Contract Documents.
- C. Nothing in this Paragraph 11.05 obligates 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.

#### 11.06 *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.C.2.

#### 11.07 *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 must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment of Contract Price must 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);
  - 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 11.07.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 11.07.C).

- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit will 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 will be 15 percent;
    - b. For costs incurred under Paragraph 13.01.B.3, the Contractor's fee will be 5 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 11.07.C.2.a and 11.07.C.2.b is that the Contractor's fee will be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.B.1 and 13.01.B.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 5 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 will be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the Work;
    - d. No fee will 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 of the Work will be the amount of the actual net decrease in Cost of the Work and a deduction of an additional amount equal to 5 percent of such actual net decrease in Cost of the Work; and
    - f. When both additions and credits are involved in any one change or Change Proposal, the adjustment in Contractor's fee will be computed by determining the sum of the costs in each of the cost categories in Paragraph 13.01.B (specifically, payroll costs, Paragraph 13.01.B.1; incorporated materials and equipment costs, Paragraph 13.01.B.2; Subcontract costs, Paragraph 13.01.B.3; special consultants costs, Paragraph 13.01.B.4; and other costs, Paragraph 13.01.B.5) and applying to each such cost category sum the appropriate fee from Paragraphs 11.07.C.2.a through 11.07.C.2.e, inclusive.

#### 11.08 *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 must comply with the provisions of Paragraph 11.09. Any Claim for an adjustment in the Contract Times must comply with the provisions of Article 12.
- B. Delay, disruption, and interference in the Work, and any related changes in Contract Times, are addressed in and governed by Paragraph 4.05.

## 11.09 *Change Proposals*

A. *Purpose and Content*: Contractor shall submit a Change Proposal to Engineer to request an adjustment in the Contract Times or Contract Price; contest an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; challenge a set-off against payment due; or seek other relief under the Contract. The Change Proposal will specify any proposed change in Contract Times or Contract Price, or other proposed relief, and explain the reason for the proposed change, with citations to any governing or applicable provisions of the Contract Documents. Each Change Proposal will address only one issue, or a set of closely related issues.

### B. *Change Proposal Procedures*

1. *Submittal*: Contractor shall submit each Change Proposal to Engineer within 30 days after the start of the event giving rise thereto, or after such initial decision.
2. *Supporting Data*: 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.
  - a. Change Proposals based on or related to delay, interruption, or interference must comply with the provisions of Paragraphs 4.05.D and 4.05.E.
  - b. Change proposals related to a change of Contract Price must include full and detailed accounts of materials incorporated into the Work and labor and equipment used for the subject Work.

The supporting data must 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.

3. *Engineer's Initial Review*: Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal. If in its discretion Engineer concludes that additional supporting data is needed before conducting a full review and making a decision regarding the Change Proposal, then Engineer may request that Contractor submit such additional supporting data by a date specified by Engineer, prior to Engineer beginning its full review of the Change Proposal.
4. *Engineer's Full Review and Action on the Change Proposal*: Upon receipt of Contractor's supporting data (including any additional data requested by Engineer), Engineer will conduct a full review of each Change Proposal and, within 30 days after such receipt of the Contractor's supporting data, either approve the Change Proposal in whole, deny it in whole, or approve it in part and deny it in part. Such actions must 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.
5. *Binding Decision*: Engineer's decision is final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.

- C. *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 in writing that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice will be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.
- D. *Post-Completion*: Contractor shall not submit any Change Proposals after Engineer issues a written recommendation of final payment pursuant to Paragraph 15.06.B.

#### 11.10 *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 are subject 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;
  - 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; and
  - 4. Subject to the waiver provisions of Paragraph 15.07, any dispute arising after Engineer has issued a written recommendation of final payment pursuant to Paragraph 15.06.B.
- 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 rests with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, 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 will 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 will 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 will 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 will 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 will 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 will 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 will be incorporated in a Change Order or other written document 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. When needed 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 will be in amounts no higher than those commonly incurred in the

locality of the Project, will not include any of the costs itemized in Paragraph 13.01.C, and will 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 in advance of the subject Work. Such employees include, without limitation, superintendents, foremen, safety managers, safety representatives, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work will be apportioned on the basis of their time spent on the Work. Payroll costs include, but are not limited to, salaries and wages plus the cost of fringe benefits, which include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, 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, will 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 accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts will accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment will 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, which 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 will 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 or retained for services specifically related to the Work.
5. Other costs consisting of 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, 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.
    - 1) In establishing included costs for materials such as scaffolding, plating, or sheeting, consideration will be given to the actual or the estimated life of the material for use on other projects; or rental rates may be established on the basis of purchase or salvage value of such items, whichever is less. Contractor will not

be eligible for compensation for such items in an amount that exceeds the purchase cost of such item.

c. *Construction Equipment Rental*

- 1) Rentals of all construction equipment and machinery, and the parts thereof, in accordance with rental agreements approved by Owner as to price (including any surcharge or special rates applicable to overtime use of the construction equipment or machinery), and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs will be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts must cease when the use thereof is no longer necessary for the Work.
  - 2) Costs for equipment and machinery owned by Contractor or a Contractor-related entity will be paid at a rate shown for such equipment in the equipment rental rate book specified in the Supplementary Conditions. An hourly rate will be computed by dividing the monthly rates by 176. These computed rates will include all operating costs.
  - 3) With respect to Work that is the result of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price ("changed Work"), included costs will be based on the time the equipment or machinery is in use on the changed Work and the costs of transportation, loading, unloading, assembly, dismantling, and removal when directly attributable to the changed Work. The cost of any such equipment or machinery, or parts thereof, must cease to accrue when the use thereof is no longer necessary for the changed 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 builder's risk or other property insurance established in accordance with Paragraph 6.04), 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 include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses will 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 does not include any of the following items:

1. Payroll costs and other compensation of Contractor's officers, executives, principals, general 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. The cost of purchasing, renting, or furnishing small tools and hand tools.
3. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
4. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
5. 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.
6. Expenses incurred in preparing and advancing Claims.
7. 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*

1. When the Work as a whole is performed on the basis of cost-plus-a-fee, then:
  - a. Contractor's fee for the Work set forth in the Contract Documents as of the Effective Date of the Contract will be determined as set forth in the Agreement.
  - b. for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work, Contractor's fee will be determined as follows:
    - 1) When the fee for the Work as a whole is a percentage of the Cost of the Work, the fee will automatically adjust as the Cost of the Work changes.
    - 2) When the fee for the Work as a whole is a fixed fee, the fee for any additions or deletions will be determined in accordance with Paragraph 11.07.C.2.
2. When the Work as a whole is performed on the basis of a stipulated sum, or any other basis other than cost-plus-a-fee, then Contractor's fee for any Work covered by a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price on the basis of Cost of the Work will be determined in accordance with Paragraph 11.07.C.2.

E. *Documentation and Audit*: Whenever the Cost of the Work for any purpose is to be determined pursuant to this Article 13, Contractor and pertinent Subcontractors will establish

and maintain records of the costs in accordance with generally accepted accounting practices. Subject to prior written notice, Owner will be afforded reasonable access, during normal business hours, to all Contractor's accounts, records, books, correspondence, instructions, drawings, receipts, vouchers, memoranda, and similar data relating to the Cost of the Work and Contractor's fee. Contractor shall preserve all such documents for a period of three years after the final payment by Owner. Pertinent Subcontractors will afford such access to Owner, and preserve such documents, to the same extent required of Contractor.

### 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 for any of the foregoing will be valid.
- C. *Owner's Contingency Allowance*: Contractor agrees that an Owner's 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 for Work covered by allowances, and the Contract Price will 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, and the final adjustment of Contract Price will be set forth in a Change Order, subject to the provisions of the following paragraph.

E. *Adjustments in Unit Price*

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
  - a. the quantity of the item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
  - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
3. Adjusted unit prices will apply to all units of that item.

**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 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 with such procedures and programs 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 will 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 will 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 will 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 written 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 will 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 additional 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, 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 will 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 defective Work as required by Engineer, then Owner may, after 7 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 for 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.
  - 2. 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 must also be accompanied by: (a) a bill of sale, invoice, copies of subcontract or purchase order payments, or other documentation establishing full payment by Contractor for the materials and equipment; (b) at Owner's

request, documentation warranting that Owner has received the materials and equipment free and clear of all Liens; and (c) 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.

3. Beginning with the second Application for Payment, each Application must include an affidavit of Contractor stating that all previous progress payments received by Contractor have been applied to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
4. 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;
  - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto;
  - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work;
  - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid by Owner; 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 based on Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages resulting from 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 has occurred that would constitute a default by Contractor and therefore justify a termination for cause;
  - j. Liquidated or other 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; or
  - l. Other items entitle 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 will 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 will be treated as an amount due as determined by Paragraph 15.01.D.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 7 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 will 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 7 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 15.03.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 6.04 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 7.12), and other documents, Contractor may make application for final payment.
2. The final Application for Payment must 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 duly pending Change Proposals and Claims; 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 Final Application and Recommendation of Payment:* 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 10 days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the final Application for Payment to Owner for payment. Such recommendation will 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. 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. *Notice of Acceptability:* In support of its recommendation of payment of the final Application for Payment, Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to stated limitations in the notice and to the provisions of Paragraph 15.07.
- D. *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 and issuance of notice of the acceptability of the Work.
- E. *Final Payment Becomes Due:* Upon receipt from Engineer of the final Application for Payment and accompanying documentation, Owner shall set off against the amount recommended by Engineer for final payment any further sum to which Owner is entitled, including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions of this Contract with respect to progress payments. Owner shall pay the resulting balance due to Contractor within 30 days of Owner's receipt of the final Application for Payment from Engineer.

#### 15.07 *Waiver of Claims*

- A. By making final payment, Owner waives its claim or right to liquidated damages or other damages for late completion by Contractor, except as set forth in an outstanding Claim,

appeal under the provisions of Article 17, set-off, or express reservation of rights by Owner. Owner reserves all other claims or rights after final payment.

- 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 as a Claim, 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 Supplementary Conditions or the terms of any applicable special guarantee required by the Contract Documents), Owner gives Contractor written notice that any Work has been found to be defective, or that Contractor's repair of any damages to the Site or adjacent areas has been found to be defective, then after receipt of such notice of defect 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 adjacent areas;
  - 2. correct such defective Work;
  - 3. remove the defective Work from the Project and replace it with Work that is not defective, if the defective Work has been rejected by Owner, 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 from the corrective measures.
- B. Owner shall give any such notice of defect within 60 days of the discovery that such Work or repairs is defective. If such notice is given within such 60 days but after the end of the correction period, the notice will be deemed a notice of defective Work under Paragraph 7.17.B.
- C. If, after receipt of a notice of defect within 60 days and within the correction period, 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 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). Contractor's failure to pay such costs, losses, and damages within 10 days of invoice from Owner will be deemed the start of an event giving rise to a Claim under Paragraph 12.01.B, such that any related Claim must be brought within 30 days of the failure to pay.
- D. 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.
- E. 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.

- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to 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 directly attributable to any such suspension. Any Change Proposal seeking such adjustments must 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) 10 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) written 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 7 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 will govern over any inconsistent provisions of Paragraphs 16.02.B and 16.02.D.

#### 16.03 *Owner May Terminate for Convenience*

- A. Upon 7 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 for any loss of anticipated profits or revenue, post-termination overhead costs, 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 7 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, 7 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, pursuant to Article 12; and
  - 2. Disputes between Owner and Contractor concerning the Work, or obligations under the Contract Documents, that arise 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;
  - 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 requires the giving of written notice to Owner, Engineer, or Contractor, it will be deemed to have been validly given only if delivered:
  - 1. in person, by a commercial courier service or otherwise, to the recipient's place of business;
  - 2. by registered or certified mail, postage prepaid, to the recipient's place of business; or
  - 3. by e-mail to the recipient, with the words "Formal Notice" or similar in the e-mail's subject line.

### **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 will not constitute a waiver of that provision, nor will 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 of the Contract or 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 *Assignment of Contract*

- A. Unless expressly agreed to elsewhere in the Contract, no assignment by a party to this Contract of any rights under or interests in the Contract will be binding on the other party 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.

18.09 *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.

18.10 *Headings*

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

**SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT**

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## SUPPLEMENTARY CONDITIONS OF THE CONSTRUCTION CONTRACT

These Supplementary Conditions amend or supplement EJCDC® C-700, Standard General Conditions of the Construction Contract (2018). The General Conditions remain in full force and effect except as amended.

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—for example, "Paragraph SC-4.05."

### ARTICLE 1—DEFINITIONS AND TERMINOLOGY

SC-1.01.A.8 – *Add the following at the end of the Paragraph:*

The Change Order form to be used on this Project is EJCDC C-941 (2018).  
Agency approval is required before Change Orders are effective.

SC-1.01.A.30 – *Add the following at the end of the Paragraph:*

For the purposes of Rural Development, this term is synonymous with the term "applicant" as defined in 7 CFR 1780.7 (a) (1), (2) and (3) and is an entity receiving financial assistance from the federal programs.

SC-1.01.A.50 – *Add the following at the end of the Paragraph:*

The Work Change Directive form to be used on this Project is EJCDC C-940 (2018). Agency approval is required before a Work Change Directive is issued.

SC-1.01.A.51 – *Add the following new paragraph immediately after Paragraph 1.01.A.50:*

**51. Agency** – The Project is financed in whole or in part by USDA Rural Utilities Service pursuant to the Consolidated Farm and Rural Development Act (7 U.S.C. Section 1921 et seq.). The Rural Utilities Service programs are administered through the USDA Rural Development offices; therefore, the Agency for these documents is USDA Rural Development.

SC-1.01.A.52 – *Add the following new paragraph with the title "Domestic Preference Definitions" immediately after Paragraph 1.01.A.51:*

**52.a Build America, Buy America Act (BABAA)** – Requirements mandated by Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901- 70953-58 mandating domestic preference that all iron and steel, manufactured products, and construction materials are produced in the United States, in accordance with 2 CFR part 184.

**52.b Construction Materials** – Those articles, materials, or supplies — other than an item of primarily iron or steel; a manufactured product; cement and

cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives— that are or consist primarily of: non-ferrous metals, plastic and polymer-based products, glass, lumber or drywall.

**52.c Contractor’s Certification** – A certification submitted by Contractor that, to the best of the Contractor’s knowledge and belief, all Work complies with Domestic Preference requirements.

**52.d De Minimis** – Materials and products that represent a small portion of an infrastructure project, specifically no more than 5% of the project costs up to a maximum of \$1,000,000,

**52.e Domestic Preference** – The Build America, Buy America Act (BABAA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953.

**52.f Engineer’s Certification** – Documentation submitted by the Engineer that Drawings, Specifications, and Bidding Documents comply with Domestic Preference requirements.

**52.g Manufactured Product** – Items assembled out of components, or otherwise made or processed from raw materials into finished products. Manufactured products must be manufactured (assembled) in the United States, and the cost of components that were mined, produced, or manufactured in the United States must be greater than 55 percent of the total cost of all components of the product.

**52.h Manufacturer’s Certification** – Documentation provided by the Manufacturer stating that Domestic Preference requirements have been satisfied for all provided items. Manufacturers’ Certifications must include (at a minimum): specific list of products (using common names) associated with the certificate, location of the final manufacturing, signature of the manufacturer’s representative, and a reference to the Domestic Preference statute. If items are purchased via a Supplier, distributor, vendor, etc. from the Manufacturer directly, then the Supplier, distributor, vendor, etc. will be responsible for obtaining and providing these certifications to the parties purchasing the products.

**52.i Minor Components** - Components within an iron and/or steel product otherwise compliant with the Domestic Preference requirements. This waiver, typically used by Manufacturers, allows use of non-domestically produced miscellaneous Minor Components comprising up to five percent of the total material cost of an otherwise domestically produced iron and steel product. However, unless a separate waiver for a product has been approved, all other iron and steel components in said product must still meet the Domestic

Preference requirements. This waiver does not exempt the whole product from the Domestic Preference requirements only Minor Components within said product and the iron or steel components of the product must be produced domestically.

**52.j Primarily Iron or Steel** - A product is made of greater than 50 percent iron or Steel on a materials cost basis.

## ARTICLE 2—PRELIMINARY MATTERS

### 2.01 Delivery of Bonds and Evidence of Insurance

SC-2.01 *Delete Paragraphs 2.01.B. and C. in their entirety and insert the following in their place:*

- B. **Evidence of Contractor's Insurance:** When Contractor delivers the signed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner copies of the policies (including all endorsements, and identification of applicable self-insured retentions and deductibles) of insurance required to be provided by Contractor in this Contract. Contractor may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- C. **Evidence of Owner's Insurance:** After receipt from Contractor of the signed counterparts of the Agreement and all required bonds and insurance documentation, Owner shall promptly deliver to Contractor copies of the policies of insurance to be provided by Owner in this Contract (if any). Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.

### 2.02 Copies of Documents

SC-2.02 *Amend the first sentence of Paragraph 2.02.A. to read as follows:*

Owner shall furnish to Contractor five printed copies of the Contract Documents (including one fully executed counterpart of the Agreement), and one copy in electronic portable document format (PDF).

### 2.03 Before Starting Construction

SC-2.03 *Amend Paragraph 2.03.A.1., adding the following text:*

The preliminary schedule shall be organized by process areas as it relates to the treatment facility. The schedule should indicate delivery lead times, dates of anticipated shutdowns, and other scheduling constraints.

### 2.06 Electronic Transmittals

SC-2.06 *Delete Paragraphs 2.06.B and 2.06.C in their entirety and insert the following in their place:*

- B. **Electronic Documents Protocol:** The parties shall conform to the following provisions in Paragraphs 2.06.B and 2.06.C, together referred to as the Electronic Documents Protocol (“EDP” or “Protocol”) for exchange of electronic transmittals.

#### 1. Basic Requirements

- a. To the fullest extent practical, the parties agree to and will transmit and accept Electronic Documents in an electronic or digital format using the procedures described in this Protocol. Use of the Electronic Documents and any information contained therein is subject to the requirements of this Protocol and other provisions of the Contract.
- b. The contents of the information in any Electronic Document will be the responsibility of the transmitting party.
- c. Electronic Documents as exchanged by this Protocol may be used in the same manner as the printed versions of the same documents that are exchanged using non-electronic format and methods, subject to the same governing requirements, limitations, and restrictions, set forth in the Contract Documents.
- d. Except as otherwise explicitly stated herein, the terms of this Protocol will be incorporated into any other agreement or subcontract between a party and any third party for any portion of the Work on the Project, or any Project-related services, where that third party is, either directly or indirectly, required to exchange Electronic Documents with a party or with Engineer. Nothing herein will modify the requirements of the Contract regarding communications between and among the parties and their subcontractors and consultants.
- e. When transmitting Electronic Documents, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the receiving party's use of software application packages, operating systems, or computer hardware differing from those established in this Protocol.
- f. Nothing herein negates any obligation 1) in the Contract to create, provide, or maintain an original printed record version of Drawings and Specifications, signed and sealed according to applicable Laws and Regulations; 2) to comply with any applicable Law or Regulation governing the signing and sealing of design documents or the signing and electronic transmission of any other documents; or 3) to comply with the notice requirements of Paragraph 18.01 of the General Conditions.

## **2. System Infrastructure for Electronic Document Exchange**

- a. Each party will provide hardware, operating system(s) software, internet, e-mail, and large file transfer functions ("System Infrastructure") at its own cost and sufficient for complying with the EDP requirements. With the exception of minimum standards set forth in this EDP, and any explicit system requirements specified by attachment to this EDP, it is the obligation of each party to determine, for itself, its own System Infrastructure.
  - 1) The maximum size of an email attachment for exchange of Electronic Documents under this EDP is 10 MB. Attachments larger than that may be exchanged using large file transfer functions or physical media.
  - 2) Each Party assumes full and complete responsibility for any and all of its own costs, delays, deficiencies, and errors associated with converting, translating,

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updating, verifying, licensing, or otherwise enabling its System Infrastructure, including operating systems and software, for use with respect to this EDP.

- b. Each party is responsible for its own system operations, security, back-up, archiving, audits, printing resources, and other Information Technology (“IT”) for maintaining operations of its System Infrastructure during the Project, including coordination with the party’s individual(s) or entity responsible for managing its System Infrastructure and capable of addressing routine communications and other IT issues affecting the exchange of Electronic Documents.
- c. Each party will operate and maintain industry-standard, industry-accepted, ISO-standard, commercial-grade security software and systems that are intended to protect the other party from: software viruses and other malicious software like worms, trojans, adware; data breaches; loss of confidentiality; and other threats in the transmission to or storage of information from the other parties, including transmission of Electronic Documents by physical media such as CD/DVD/flash drive/hard drive. To the extent that a party maintains and operates such security software and systems, it shall not be liable to the other party for any breach of system security.
- d. In the case of disputes, conflicts, or modifications to the EDP required to address issues affecting System Infrastructure, the parties shall cooperatively resolve the issues; but, failing resolution, the Owner is authorized to make and require reasonable and necessary changes to the EDP to effectuate its original intent. If the changes cause additional cost or time to Contractor, not reasonably anticipated under the original EDP, Contractor may seek an adjustment in price or time under the appropriate process in the Contract.
- e. Each party is responsible for its own back-up and archive of documents sent and received during the term of the contract under this EDP, unless this EDP establishes a Project document archive, either as part of a mandatory Project website or other communications protocol, upon which the parties may rely for document archiving during the specified term of operation of such Project document archive. Further, each party remains solely responsible for its own post-Project back-up and archive of Project documents after the term of the Contract, or after termination of the Project document archive, if one is established, for as long as required by the Contract and as each party deems necessary for its own purposes.
- f. If a receiving party receives an obviously corrupted, damaged, or unreadable Electronic Document, the receiving party will advise the sending party of the incomplete transmission.
- g. The parties will bring any non-conforming Electronic Documents into compliance with the EDP. The parties will attempt to complete a successful transmission of the Electronic Document or use an alternative delivery method to complete the communication.
- h. The Owner will operate a Project information management system (also referred to in this EDP as “Project Website”) for use of Owner, Engineer and Contractor during the Project for exchange and storage of Project-related communications

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and information. Except as otherwise provided in this EDP or the General Conditions, use of the Project Website by the parties as described in this Paragraph will be mandatory for exchange of Project documents, communications, submittals, and other Project-related information. The following conditions and standards will govern use of the Project Website:

- 1) See specification 01312

**C. Software Requirements for Electronic Document Exchange; Limitations**

1. Each party will acquire the software and software licenses necessary to create and transmit Electronic Documents and to read and to use any Electronic Documents received from the other party (and if relevant from third parties), using the software formats required in this section of the EDP.
  - a. Prior to using any updated version of the software required in this section for sending Electronic Documents to the other party, the originating party will first notify and receive concurrence from the other party for use of the updated version or adjust its transmission to comply with this EDP.
2. The parties agree not to intentionally edit, reverse engineer, decrypt, remove security or encryption features, or convert to another format for modification purposes any Electronic Document or information contained therein that was transmitted in a software data format, including Portable Document Format (PDF), intended by sender not to be modified, unless the receiving party obtains the permission of the sending party or is citing or quoting excerpts of the Electronic Document for Project purposes.
3. Software and data formats for exchange of Electronic Documents will conform to the requirements set forth in Exhibit A to this EDP, including software versions, if listed.

SC-2.06 *Supplement Paragraph 2.06 of the General Conditions by adding the following paragraph:*

**D. Requests by Contractor for Electronic Documents in Other Formats**

1. Release of any Electronic Document versions of the Project documents in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be at the sole discretion of the Owner.
2. To extent determined by Owner, in its sole discretion, to be prudent and necessary, release of Electronic Documents versions of Project documents and other Project information requested by Contractor ("Request") in formats other than those identified in the Electronic Documents Protocol (if any) or elsewhere in the Contract will be subject to the provisions of the Owner's response to the Request, and to the following conditions to which Contractor agrees:
  - a. The content included in the Electronic Documents created by Engineer and covered by the Request was prepared by Engineer as an internal working document for Engineer's purposes solely, and is being provided to Contractor on an "AS IS" basis without any warranties of any kind, including, but not limited to any implied warranties of fitness for any purpose. As such, Contractor is advised and acknowledges that the content may not be suitable for Contractor's application, or may require substantial modification and independent verification by Contractor.

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The content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications, undocumented intermediate revisions, and other devices that may affect subsequent reuse.

- b. Electronic Documents containing text, graphics, metadata, or other types of data that are provided by Engineer to Contractor under the request are only for convenience of Contractor. Any conclusion or information obtained or derived from such data will be at the Contractor's sole risk and the Contractor waives any claims against Engineer or Owner arising from use of data in Electronic Documents covered by the Request.
- c. Contractor shall indemnify and hold harmless Owner and Engineer and their subconsultants from all claims, damages, losses, and expenses, including attorneys' fees and defense costs arising out of or resulting from Contractor's use, adaptation, or distribution of any Electronic Documents provided under the Request.
- d. Contractor agrees not to sell, copy, transfer, forward, give away or otherwise distribute this information (in source or modified file format) to any third party without the direct written authorization of Engineer, unless such distribution is specifically identified in the Request and is limited to Contractor's subcontractors. Contractor warrants that subsequent use by Contractor's subcontractors complies with all terms of the Contract Documents and Owner's response to Request.

### **ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE**

No changes to this article.

### **ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK**

SC-4.01.A *Delete the paragraph, and replace with:*

- A. The Contract Times will commence on the day indicated in the Notice to Proceed. The Notice to Proceed date must be no later than 30 days after the Effective Date of the Contract. The Owner must issue a Notice to Proceed.

#### **4.05 Delays in Contractor's Progress**

SC-4.05 *Amend Paragraph 4.05.C by adding the following subparagraphs:*

##### **5. Weather-Related Delays**

- a. If "abnormal weather conditions" as set forth in Paragraph 4.05.C.2 of the General Conditions are the basis for a request for an equitable adjustment in the Contract Times, such request must be documented by data substantiating each of the following: 1) that weather conditions were abnormal for the period of time in which the delay occurred, 2) that such weather conditions could not have been reasonably anticipated, and 3) that such weather conditions had an adverse effect on the Work as scheduled. Extreme or unusual weather that is typical for a given region, elevation, or season should not be considered abnormal weather

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conditions. Requests for time extensions due to abnormal weather conditions will be submitted to the Engineer within five days of the end of the abnormal weather condition event. It is the responsibility of the Contractor to provide the information listed in SC 4.05.C.5.b.

- b. The existence of abnormal weather conditions will be determined on a month-by-month basis in accordance with the following:
  - 1) Every workday on which one or more of the following conditions exist will be considered a “bad weather day”:
    - i) Total precipitation (as rain equivalent) occurring between 7:00 p.m. on the preceding day (regardless of whether such preceding day is a workday) through 7:00 p.m. on the workday in question equals or exceeds 0.50 inches of precipitation (as rain equivalent, based on the snow/rain conversion indicated in the table entitled Foreseeable Bad Weather Days; such table is hereby incorporated in this SC-4.05.C by reference).
    - ii) Ambient outdoor air temperature at 11:00 a.m. is equal to or less than the following low temperature threshold: 32 degrees Fahrenheit; or, at 3:00 p.m. the ambient outdoor temperature is equal to or greater than the following high temperature threshold: 95 degrees Fahrenheit.
  - 2) Determination of actual bad weather days during performance of the Work will be based on the weather records measured and recorded by National Weather Service (NOAA) Cooperative Station “Calaveras Big Trees” (ARNC1), located near 38.28° N, 120.31° W, elevation ~4,695 ft.
  - 3) Contractor shall anticipate the number of foreseeable bad weather days per month indicated in the table in Exhibit B—Foreseeable Bad Weather Days.
  - 4) In each month, every bad weather day exceeding the number of foreseeable bad weather days established in the table in Exhibit B—Foreseeable Bad Weather Days will be considered as “abnormal weather conditions.” The existence of abnormal weather conditions will not relieve Contractor of the obligation to demonstrate and document that delays caused by abnormal weather are specific to the planned work activities or that such activities thus delayed were on Contractor’s then-current Progress Schedule’s critical path for the Project.

## **ARTICLE 5—SITE, SUBSURFACE AND PHYSICAL CONDITIONS, HAZARDOUS ENVIRONMENTAL CONDITIONS**

### **5.03 Subsurface and Physical Conditions**

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

- E. The following table lists the reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data, and specifically identifies the Technical Data in the report upon which Contractor may rely:

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Report Title	Date of Report	Technical Data
Geotechnical Engineering Study – Calaveras County Water District – Arnold Wastewater Treatment Facility Improvements Project	August 18, 2021	Geotechnical information

- G. Contractor may examine copies of reports and drawings identified in SC-5.03.E that were not included with the Bidding Documents by requesting copies from the Engineer.

#### 5.06 Hazardous Environmental Conditions

SC-5.06 *Add the following new paragraphs immediately after Paragraph 5.06.A.3:*

4. The following table lists the reports known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and the Technical Data (if any) upon which Contractor may rely:

Report Title	Date of Report	Technical Data
No reports available		

5. The following table lists the drawings known to Owner relating to Hazardous Environmental Conditions at or adjacent to the Site, and Technical Data (if any) contained in such Drawings upon which Contractor may rely:

Drawings Title	Date of Drawings	Technical Data
No drawings available		

### ARTICLE 6—BONDS AND INSURANCE

#### 6.01 Performance, Payment, and Other Bonds

SC-6.01 *Add the following paragraphs immediately after Paragraph 6.01.A:*

- Required Performance Bond Form:** The performance bond that Contractor furnishes will be in the form of EJCDC® C-610, Performance Bond.
- Required Payment Bond Form:** The payment bond that Contractor furnishes will be in the form of EJCDC® C-615, Payment Bond.

SC-6.01 *Add the following paragraphs immediately after Paragraph 6.01.B:*

- The correction period specified as one year after the date of Substantial Completion in Paragraph 15.08.A of the General Conditions is hereby revised to be 2 years after Substantial Completion.
- After Substantial Completion, Contractor shall furnish a warranty bond issued in the form of EJCDC® C-612, Warranty Bond (2018). The warranty bond must be in a bond amount of 15 percent of the final Contract Price. The warranty bond period will extend to a date 2 years after Substantial Completion of the Work. Contractor shall deliver the fully executed warranty bond to Owner prior to or with the final application for payment, and in any event no later than 11 months after Substantial Completion.

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3. The warranty bond must be issued by the same surety that issues the performance bond required under Paragraph 6.01.A of the General Conditions.

**6.02 Insurance—General Provisions**

SC-6.02 *Add the following paragraph immediately after Paragraph 6.02.B:*

1. Contractor may obtain worker’s compensation insurance from an insurance company that has not been rated by A.M. Best, provided that such company (a) is domiciled in the state in which the Project is located, (b) is certified or authorized as a worker’s compensation insurance provider by the appropriate state agency, and (c) has been accepted to provide worker’s compensation insurance for similar projects by the state within the last 12 months.

SC-6.02 *Add the following paragraph immediately after Paragraph 6.02.H.2 of the General Conditions:*

3. For the following Subcontractors, Suppliers, or categories of Subcontractor or Supplier, Contractor shall require the following specified insurance, with policy limits as stated: All Subcontractors to have same insurance limits as Prime Contractor.

**6.03 Contractor’s Insurance**

SC-6.03 *Supplement Paragraph 6.03 with the following provisions after Paragraph 6.03.C:*

- D. **Other Additional Insureds:** As a supplement to the provisions of Paragraph 6.03.C of the General Conditions, the commercial general liability, automobile liability, umbrella or excess, pollution liability, and unmanned aerial vehicle liability policies must include as additional insureds (in addition to Owner and Engineer) the following:
  1. Calaveras County Water District
  2. County of Calaveras
  3. United States Department of Agriculture (USDA)
  4. Resident Engineer/Resident Project Representative (as designated by Owner)
- E. **Workers’ Compensation and Employer’s Liability:** Contractor shall purchase and maintain workers’ compensation and employer’s liability insurance, including, as applicable, United States Longshoreman and Harbor Workers’ Compensation Act, Jones Act, stop-gap employer’s liability coverage for monopolistic states, and foreign voluntary workers’ compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

<b>Workers’ Compensation and Related Policies</b>	<b>Policy limits of not less than:</b>
<b>Workers’ Compensation</b>	
State	Statutory
Applicable Federal (e.g., Longshoreman’s)	Statutory
Foreign voluntary workers’ compensation (employer’s responsibility coverage), if applicable	Statutory
<b>Employer’s Liability</b>	

<b>Workers' Compensation and Related Policies</b>	<b>Policy limits of not less than:</b>
Each accident	\$2,000,000
Each employee	\$2,000,000
Policy limit	\$2,000,000

- F. **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 claims for:
1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
  2. damages insured by reasonably available personal injury liability coverage, and
  3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- G. **Commercial General Liability—Form and Content:** Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage.
    - a. Such insurance must 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, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
  3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
  4. Underground, explosion, and collapse coverage.
  5. Personal injury coverage.
  6. 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). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
  7. 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.
- H. **Commercial General Liability—Excluded Content:** The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:

1. Any modification of the standard definition of “insured contract” (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
2. Any exclusion for water intrusion or water damage.
3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
4. Any exclusion of coverage relating to earth subsidence or movement.
5. Any exclusion for the insured’s vicarious liability, strict liability, or statutory liability (other than worker’s compensation).
6. Any limitation or exclusion based on the nature of Contractor’s work.
7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.

**I. Commercial General Liability—Minimum Policy Limits**

<b>Commercial General Liability</b>	<b>Policy limits of not less than:</b>
General Aggregate	\$2,000,000
Products—Completed Operations Aggregate	\$2,000,000
Personal and Advertising Injury	\$2,000,000
Bodily Injury and Property Damage—Each Occurrence	\$2,000,000

- J. Automobile Liability:** Contractor shall purchase and maintain automobile liability insurance 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 must be written on an occurrence basis.

<b>Automobile Liability</b>	<b>Policy limits of not less than:</b>
<b>Combined Single Limit</b>	
Combined Single Limit (Bodily Injury and Property Damage)	\$2,000,000

- K. 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. The coverage afforded must be at least as broad as that of each and every one of the underlying policies.

<b>Excess or Umbrella Liability</b>	<b>Policy limits of not less than:</b>
Each Occurrence	\$2,000,000
General Aggregate	\$2,000,000

- L. Using Umbrella or Excess Liability Insurance to Meet CGL and Other Policy Limit Requirements:** Contractor may meet the policy limits specified for employer’s liability,

commercial general liability, and automobile liability through the primary policies alone, or through combinations of the primary insurance policy's policy limits and partial attribution of the policy limits of an umbrella or excess liability policy that is at least as broad in coverage as that of the underlying policy, as specified herein. If such umbrella or excess liability policy was required under this Contract, at a specified minimum policy limit, such umbrella or excess policy must retain a minimum limit of \$2,000,000 after accounting for partial attribution of its limits to underlying policies, as allowed above.

## **ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES**

### **7.03 Labor; Working Hours**

SC-7.03 Add the following new subparagraphs immediately after Paragraph 7.03.C:

1. Regular working hours will be 7:00am – 4:30pm.
2. Owner's legal holidays are New Year's Day, President's Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Martin Luther King Jr. Day, and Christmas Day.

SC-7.03 Add the following new paragraph immediately after Paragraph 7.03.C:

- D. Contractor shall be responsible for the cost of any overtime pay or other expense incurred by the Owner for Engineer's services (including those of the Resident Project Representative, if any), Owner's representative, and construction observation services, occasioned by the performance of Work on Saturday, Sunday, any legal holiday, or as overtime on any regular work day. If Contractor is responsible but does not pay, or if 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.

SC-7.04.D Add the following new paragraph immediately after Paragraph 7.04.C:

- D. All products must meet Domestic Preference requirements.

SC-7.04.E Add the following new paragraph immediately after Paragraph 7.04.D:

- E. For projects utilizing a De Minimis waiver, Contractor shall maintain an itemized list of non-domestically produced components and ensure that the cost is less than 5% of total project cost for project up to a maximum of \$1,000,000.

SC-7.05.A Amend the third sentence of paragraph by striking out the following words:

Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item is permitted,

SC-7.05.A.1.a.3 Amend the last sentence of Paragraph a.3 by striking out "and;" and adding a period at the end of Paragraph a.3.

SC-7.05.A.1.a.4 Delete paragraph in its entirety and insert "Deleted."

SC-7.05.B Add the following at the end of paragraph:

Contractor shall include a Manufacturer's Certification or waiver for compliance with Domestic Preference requirements and supporting data, as applicable. Refer to

Sample Language for Manufacturer's Certification provided at the end of the Supplementary Conditions section.

SC-7.06.A.3.a.2 *Remove "and" from the end of paragraph.*

SC- 7.06.A.3.a.3 *Add "; and" to the end of paragraph.*

SC-7.06.A.3.a.4 *Add the following new paragraph immediately after Paragraph 7.06.A.3.a.3:*

1. Comply with Domestic Preference requirements by providing Manufacturer's Certification or waiver, as applicable. Refer to Sample Language for Manufacturers' Certification provided at the end of the Supplementary Conditions section.

SC-7.07.B *Delete paragraph in its entirety and insert "Deleted".*

SC-7.07.E *Delete the second sentence of paragraph and insert the following in its place:*

Owner may not require that Contractor use a specific replacement.

SC-7.12.A *Amend paragraph by adding the following after "written interpretations and clarifications,":*  
Manufacturers' Certifications,

SC-7.16.A.1.c *Amend paragraph by deleting the last period and adding:*

, including Manufacturer's Certification, or waiver for any item in the submittal subject to Domestic Preference requirements. Refer to the Sample Language for Manufacturers' Certification provided at the end of the Supplementary Conditions section.

SC-7.16.C.9 *Add new paragraph immediately after Paragraph 7.16.C.8:*

1. Engineer's review and approval of a Shop Drawing or Sample shall include review of Manufacturers' Certifications and any waivers to document compliance with Domestic Preference requirements, as applicable.

SC-7.17.F *Add new paragraph immediately after Paragraph 7.17.E:*

F. Contractor shall certify prior to final payment that all Work and Materials have complied with Domestic Preference requirements. Contractor shall provide Certification to Owner and Engineer. Refer to the Sample Language for Contractor's Certification provided at the end of the Supplementary Conditions section.

## **ARTICLE 8—OTHER WORK AT THE SITE**

No changes to this article

## **ARTICLE 9—OWNER'S RESPONSIBILITIES**

No changes to this article

## ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

### 10.03 Resident Project Representative

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

- C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:
1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.
  2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.
  3. *Liaison*
    - a. Serve as Engineer'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.
    - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
    - c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.
  4. *Review of Work; Defective Work*
    - a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.
    - b. Observe whether any Work in place appears to be defective.
    - c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.
  5. *Inspections and Tests*
    - a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to those performed by public or other agencies having jurisdiction over the Work.
    - b. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.
  6. *Payment Requests:* Review Applications for Payment with Contractor.
  7. *Completion*

- a. Participate in Engineer’s visits regarding Substantial Completion.
  - b. Assist in the preparation of a punch list of items to be completed or corrected.
  - c. Participate in Engineer’s visit to the Site in the company of Owner and Contractor regarding completion of the Work, and prepare a final punch list of items to be completed or corrected by Contractor.
  - d. Observe whether items on the final punch list have been completed or corrected.
- D. The RPR will 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 construction.
  - 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. Authorize Owner to occupy the Project in whole or in part.

**ARTICLE 11—CHANGES TO THE CONTRACT**

SC-11.02.C *Add new paragraph immediately after Paragraph 11.02.B:*

- C. The Engineer or Owner shall contact the Agency for concurrence on each Change Order prior to issuance. All Contract Change Orders must be concurred on (signed) by Agency before they are effective.

SC-11.03.A.2 *Add new Paragraph 11.03.A.2 immediately after Paragraph 11.03.A, which shall be renamed Paragraph 11.03.A.1:*

- 2. The Engineer or Owner shall contact the Agency for concurrence on each Work Change Directive prior to issuance. Once authorized by Owner, a copy of each Work Change Directive shall be provided by Engineer to the Agency.

SC-11.05.B *Add the following at the end of this paragraph:*

For Owner-authorized changes in the Work, the Contractor will provide the Manufacturer’s Certification, or waiver, for materials subject to Domestic Preference requirements except when sole-source is specified, in which case the Engineer will provide the Manufacturer’s Certification, or waiver.

SC-11.09.B.2.c *Add new paragraph immediately after Paragraph 11.09.B.2.b:*

- c. For change orders involving materials subject to Domestic Preference requirements, Contractor shall include a Manufacturer's Certification or waiver, as applicable. Refer to the Sample Language for Manufacturer's Certification provided at the end of the Supplementary Conditions section.

## **ARTICLE 12—CLAIMS**

*Add the following immediately after Article 12.01 Claims:*

12.02 – State of California/Public Contract Code §9204

SC-12.02 Resolution of claims in connection with public works projects

- (a) The Legislature finds and declares that it is in the best interests of the state and its citizens to ensure that all construction business performed on a public works project in the state that is complete and not in dispute is paid in full and in a timely manner.
- (b) Notwithstanding any other law, including, but not limited to, Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2, Chapter 10 (commencing with Section 19100) of Part 2, and Article 1.5 (commencing with Section 20104) of Chapter 1 of Part 3, this section shall apply to any claim by a contractor in connection with a public works project.
- (c) For purposes of this section:
  - (1) "Claim" means a separate demand by a contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following:
    - (A) A time extension, including, without limitation, for relief from damages or penalties for delay assessed by a public entity under a contract for a public works project.
    - (B) Payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.
    - (C) Payment of an amount that is disputed by the public entity.
  - (2) "Contractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who has entered into a direct contract with a public entity for a public works project.
  - (3)
    - (A) "Public entity" means, without limitation, except as provided in subparagraph (B), a state agency, department, office, division, bureau, board, or commission, the California State University, the University of California, a city, including a charter city, county, including a charter county, city and county, including a charter city and county, district, special

district, public authority, political subdivision, public corporation, or nonprofit transit corporation wholly owned by a public agency and formed to carry out the purposes of the public agency.

(B) "Public entity" shall not include the following:

(i) Department of Water Resources, (ii) Department of Transportation. (iii) Department of Parks and Recreation, (iv) Department of Corrections and Rehabilitation, (v) Military Department. (vi) Department of General Services, or (vii) High-Speed Rail Authority

(4) "Public works project" means the erection, construction, alteration, repair, or improvement of any public structure, building, road, or other public improvement of any kind.

(5) "Subcontractor" means any type of contractor within the meaning of Chapter 9 (commencing with Section 7000) of Division 3 of the Business and Professions Code who either is in direct contract with a contractor or is a lower tier subcontractor.

(d)

(1)

(A) Upon receipt of a claim pursuant to this section, the public entity to which the claim applies shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the claimant a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, a public entity and a contractor may, by mutual agreement, extend the time period provided in this subdivision.

(B) The claimant shall furnish reasonable documentation to support the claim.

(C) If the public entity needs approval from its governing body to provide the claimant a written statement identifying the disputed portion and the undisputed portion of the claim, and the governing body does not meet within the 45 days or within the mutually agreed to extension of time following receipt of a claim sent by registered mail or certified mail, return receipt requested, the public entity shall have up to three days following the next duly publicly noticed meeting of the governing body after the 45-day period, or extension, expires to provide the claimant a written statement identifying the disputed portion and the undisputed portion.

(D) Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. If the public entity fails to issue a written statement, paragraph (3) shall apply.

(2)

(A) If the claimant disputes the public entity's written response, or if the public entity fails to respond to a claim issued pursuant to this section within the time prescribed, the claimant may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, the

public entity shall schedule a meet and confer conference within 30 days for settlement of the dispute.

- (B) Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the public entity shall provide the claimant a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the public entity issues its written statement. Any disputed portion of the claim, as identified by the contractor in writing, shall be submitted to nonbinding mediation, with the public entity and the claimant sharing the associated costs equally. The public entity and claimant shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing. If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator. If mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.
  - (C) For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to timeframes in this section.
  - (D) Unless otherwise agreed to by the public entity and the contractor in writing, the mediation conducted pursuant to this section shall excuse any further obligation under Section 20104.4 to mediate after litigation has been commenced.
  - (E) This section does not preclude a public entity from requiring arbitration of disputes under private arbitration or the Public Works Contract Arbitration Program, if mediation under this section does not resolve the parties' dispute.
- (3) Failure by the public entity to respond to a claim from a contractor within the time periods described in this subdivision or to otherwise meet the time requirements of this section shall result in the claim being deemed rejected in its entirety. A claim that is denied by reason of the public entity's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of the claimant.
  - (4) Amounts not paid in a timely manner as required by this section shall bear interest at 7 percent per annum.
  - (5) If a subcontractor or a lower tier subcontractor lacks legal standing to assert a claim against a public entity because privity of contract does not exist, the contractor may present to the public entity a claim on behalf of a subcontractor or lower tier subcontractor. A subcontractor may request in writing, either on their own behalf or on behalf of a lower tier subcontractor, that the contractor present a claim for work which

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was performed by the subcontractor or by a lower tier subcontractor on behalf of the subcontractor. The subcontractor requesting that the claim be presented to the public entity shall furnish reasonable documentation to support the claim. Within 45 days of receipt of this written request, the contractor shall notify the subcontractor in writing as to whether the contractor presented the claim to the public entity and, if the original contractor did not present the claim, provide the subcontractor with a statement of the reasons for not having done so.

- (e) The text of this section or a summary of it shall be set forth in the plans or specifications for any public works project that may give rise to a claim under this section.
- (f) A waiver of the rights granted by this section is void and contrary to public policy, provided, however, that:
  - (1) Upon receipt of a claim, the parties may mutually agree to waive, in writing, mediation and proceed directly to commencement of a civil action or binding arbitration, as applicable; and
  - (2) A public entity may prescribe reasonable change order, claim, and dispute resolution procedures and requirements in addition to the provisions of this section, so long as the contractual provisions do not conflict with or otherwise impair the timeframes and procedures set forth in this section.
- (g) This section applies to contracts entered into on or after January 1, 2017.
- (h) Nothing in this section shall impose liability upon a public entity that makes loans or grants available through a competitive application process, for the failure of an awardee to meet its contractual obligations.
- (i) This section shall remain in effect only until January 1, 2027, and as of that date is repealed, unless a later enacted statute that is enacted before January 1, 2027, deletes or extends that date.

## **ARTICLE 13—COST OF WORK; ALLOWANCES, UNIT PRICE WORK**

### **13.01 Cost of the Work**

SC-13.01 *Supplement Paragraph 13.01.B.5.c.(2) by adding the following sentence:*

The equipment rental rate book that governs the included costs for the rental of machinery and equipment owned by Contractor (or a related entity) under the Cost of the Work provisions of this Contract is the most current edition of State of California, Department of Transportation (Caltrans) Equipment Rental Rates.

SC-13.01 *Supplement Paragraph 13.01.C.2 by adding the following definition of small tools and hand tools:*

- a. For purposes of this paragraph, “small tools and hand tools” means any tool or equipment whose current price if it were purchased new at retail would be less than \$1,000.

SC-13.02.C—*Delete paragraph in its entirety and insert “Deleted”.*

### **13.03 Unit Price Work**

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SC-13.03 *Delete Paragraph 13.03.E in its entirety and insert the following in its place:*

**E. Adjustments in Unit Price**

1. Contractor or Owner shall be entitled to an adjustment in the unit price with respect to an item of Unit Price Work if:
  - a. the extended price of a particular item of Unit Price Work amounts to five percent or more of the Contract Price (based on estimated quantities at the time of Contract formation) and the variation in the quantity of that particular item of Unit Price Work actually furnished or performed by Contractor differs by more than 25 percent from the estimated quantity of such item indicated in the Agreement; and
  - b. Contractor's unit costs to perform the item of Unit Price Work have changed materially and significantly as a result of the quantity change.
2. The adjustment in unit price will account for and be coordinated with any related changes in quantities of other items of Work, and in Contractor's costs to perform such other Work, such that the resulting overall change in Contract Price is equitable to Owner and Contractor.
3. Adjusted unit prices will apply to all units of that item.

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

14.03.G *Add new paragraph immediately after Paragraph 14.03.F:*

- G. Installation of materials that are non-compliant with Domestic Preference requirements shall be considered defective work. Contractor should ensure that Engineer has an approved Manufacturer's Certification, or waiver, prior to any domestic preference compliant item being delivered to the project site.

**ARTICLE 15—PAYMENTS TO CONTRACTOR, SET OFFS; COMPLETIONS; CORRECTION PERIOD**

SC-15.01.B.4 *Add the following language at the end of paragraph*

No payments will be made that would deplete the retainage, place in escrow any funds that are required for retainage, or invest the retainage for the benefit of the Contractor.

SC-15.01.B.5 *Add new paragraph immediately after Paragraph 15.01.B.4:*

1. The Application for Payment form to be used on this Project is EJCDC® C-620. The Agency must approve all Applications for Payment before payment is made.

SC-15.01.B.6 *Add new paragraph immediately after Paragraph 15.01.B.5:*

2. By submitting an Application for Payment, based in whole or in part on furnishing equipment or materials, Contractor certifies that such equipment and materials are compliant with Domestic Preference requirements. Manufacturer's Certification for material(s) satisfy these requirements. Refer to the Sample Language for

Manufacturer's Certification provided at the end of the Supplementary Conditions section.

SC-15.01.C.2.d *Add the following new paragraph after Paragraph 15.01.C.2.c:*

- d. The materials presented for payment in an Application for Payment comply with Domestic Preference requirements.

SC-15.01.D.1 *Delete paragraph in its entirety and insert the following in its place:*

The Application for Payment with Engineer's recommendations will be presented to the Owner and Agency for consideration. If both the Owner and Agency find the Application for Payment acceptable, the recommended amount less any reduction under the provisions of Paragraph 15.01.E will become due twenty (20) days after the Application for Payment is presented to the Owner, and the Owner will make payment to the Contractor.

SC-15.02.A *Amend paragraph by striking out the following text: "7 days after".*

SC-15.03.A *Modify by adding the following after the last sentence:*

Contractor shall also submit the Contractor's Certification of Compliance certifying that to the best of the Contractor's knowledge and belief all Iron and Steel products, Manufactured Products, and Construction Materials proposed in the Shop Drawings, Change Orders, and Partial Payment Estimates, and those installed for the Project, comply with Domestic Preference requirements.

SC-15.01.F *Add the following new paragraph:*

- F. For contracts in which the Contract Price is based on the Cost of Work, if Owner determines that progress payments made to date substantially exceed the actual progress of the Work (as measured by reference to the Schedule of Values), or present a potential conflict with the Guaranteed Maximum Price, then Owner may require that Contractor prepare and submit a plan for the remaining anticipated Applications for Payment that will bring payments and progress into closer alignment and take into account the Guaranteed Maximum Price (if any), through reductions in billings, increases in retainage, or other equitable measures. Owner will review the plan, discuss any necessary modifications, and implement the plan as modified for all remaining Applications for Payment.

### 15.03 **Substantial Completion**

SC-15.03 *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, will 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 this Article 15.

### 15.06 **Final Payment**

15.06 *Delete the last sentence in Paragraph 15.06.E. and replace with following:*

Thirty-five days after the filing of a Notice of Completion (conforming with Cal. Civil Code 8414), with the County Recorder and after presentation to Owner of the Application for Payment and accompanying documentation, the amount recommended by Engineer, less any sum Owner is owed.

## **ARTICLE 16—SUSPENSION OF WORK AND TERMINATION**

SC-16.01 *Immediately after Paragraph A., add Paragraph B. as follows:*

- B. The above paragraph A., concerning the Contractor's recovery of additional costs and extension of time, does not apply to suspensions of work for "winter shutdowns" of the job site that are pre-planned as identified in the contract documents as issued for bids or by addenda acknowledged at the time of submitting a bid.

## **ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES**

### **17.02 Arbitration**

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

### **17.02 Arbitration**

- A. All matters subject to final resolution under this Article will be settled by arbitration administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules (subject to the conditions and limitations of this Paragraph SC-17.02). Any controversy or claim in the amount of \$100,000 or less will be settled in accordance with the American Arbitration Association's supplemental rules for Fixed Time and Cost Construction Arbitration. This agreement to arbitrate will be specifically enforceable under the prevailing law of any court having jurisdiction.
- B. The demand for arbitration will be filed in writing with the other party to the Contract and with the selected arbitration administrator, and a copy will be sent to Engineer for information. The demand for arbitration will be made within the specific time required in Article 17, or if no specified time is applicable within a reasonable time after the matter in question has arisen, and in no event will any such demand be made after the date when institution of legal or equitable proceedings based on such matter in question would be barred by the applicable statute of limitations.
- C. The arbitrator(s) must be licensed engineers, contractors, attorneys, or construction managers. Hearings will take place pursuant to the standard procedures of the Construction Arbitration Rules that contemplate in-person hearings. The arbitrators will have no authority to award punitive or other damages not measured by the prevailing party's actual damages, except as may be required by statute or the Contract. Any award in an arbitration initiated under this clause will be limited to monetary damages and include no injunction or direction to any party other than the direction to pay a monetary amount.
- D. The Arbitrators will have the authority to allocate the costs of the arbitration process among the parties, but will only have the authority to allocate attorneys' fees if a specific Law or Regulation or this Contract permits them to do so.

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- E. The award of the arbitrators must be accompanied by a reasoned written opinion and a concise breakdown of the award. The written opinion will cite the Contract provisions deemed applicable and relied on in making the award.
- F. The parties agree that failure or refusal of a party to pay its required share of the deposits for arbitrator compensation or administrative charges will constitute a waiver by that party to present evidence or cross-examine witness. In such event, the other party shall be required to present evidence and legal argument as the arbitrator(s) may require for the making of an award. Such waiver will not allow for a default judgment against the non-paying party in the absence of evidence presented as provided for above.
- G. No arbitration arising out of or relating to the Contract will include by consolidation, joinder, or in any other manner any other individual or entity (including Engineer, and Engineer's consultants and the officers, directors, partners, agents, employees or consultants of any of them) who is not a party to this Contract unless:
  - 1. the inclusion of such other individual or entity will allow complete relief to be afforded among those who are already parties to the arbitration;
  - 2. such other individual or entity is substantially involved in a question of law or fact which is common to those who are already parties to the arbitration, and which will arise in such proceedings;
  - 3. such other individual or entity is subject to arbitration under a contract with either Owner or Contractor, or consents to being joined in the arbitration; and
  - 4. the consolidation or joinder is in compliance with the arbitration administrator's procedural rules.
- H. The award will be final. Judgment may be entered upon it in any court having jurisdiction thereof, and it will not be subject to modification or appeal, subject to provisions of the Laws and Regulations relating to vacating or modifying an arbitral award.
- I. Except as may be required by Laws or Regulations, neither party nor an arbitrator may disclose the existence, content, or results of any arbitration hereunder without the prior written consent of both parties, with the exception of any disclosure required by Laws and Regulations or the Contract. To the extent any disclosure is allowed pursuant to the exception, the disclosure must be strictly and narrowly limited to maintain confidentiality to the extent possible.

### 17.03 Attorneys' Fees

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

### 17.03 Attorneys' Fees

- A. 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**

*Add the following new article after Article 18.10 in the supplementary conditions:*

### **18.11 Antitrust Claim Settlement**

SC-18.11 In entering into a public works contract or a subcontract to supply goods, services, or materials pursuant to a public works contract, the Contractor or Subcontractor offers and agrees to assign to the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 15) or under the Cartwright Act (Chapter 2 (commencing with Section 16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services, or materials pursuant to the public works contract or the subcontract. This assignment shall be made and become effective at the time the awarding body tenders final payment to the Contractor, without further acknowledgment by the parties.

*Add the following new Article 19:*

## **ARTICLE 19—FEDERAL REQUIREMENTS**

### **SC-19.01 Agency Not a Party**

- A. This Contract is expected to be funded in part with funds provided by Agency. Neither Agency, nor any of its departments, entities, or employees is a party to this Contract.

### **SC 19.02 Contract Approval**

- A. Owner and Contractor will furnish Owner's attorney such evidence as required so that Owner's attorney can complete and execute the "Certificate of Owner's Attorney" before Owner submits the executed Contract Documents to Agency for approval.
- B. Agency concurrence is required for both the Bid and the Contract before the Contract is effective for funding reimbursement.

### **SC-19.03 Conflict of Interest & Gratuities**

- A. Contractor may not knowingly contract with a Supplier or Manufacturer if the individual or entity who prepared the Drawing and Specifications has a corporate or financial affiliation with the Supplier or Manufacturer. Owner's officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest in or other interest in or a tangible personal benefit from the Contractor. Owner's officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from Contractor or subcontractors.

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#### SC-19.04 **Gratuities**

- A. If Owner finds after a notice and hearing that Contractor, or any of Contractor's agents or representatives, offered or gave gratuities (in the form of entertainment, gifts, or otherwise) to any official, employee, or agent of Owner or Agency in an attempt to secure this Contract or favorable treatment in awarding, amending, or making any determinations related to the performance of this Contract, Owner may, by written notice to Contractor, terminate this Contract. Owner may also pursue other rights and remedies that the law or this Contract provides. However, the existence of the facts on which Owner bases such findings shall be an issue and may reviewed in proceedings under the dispute resolution provisions of this Contract.
- B. In the event this Contract is terminated as provided in paragraph 19.04.A, Owner may pursue the same remedies against Contractor as it could pursue in the event of a breach of this Contract by Contractor. As a penalty, in addition to any other damages to which it may be entitled by law, Owner may pursue exemplary damages in an amount (as determined by Owner) which shall not be less than three nor more than ten times the costs Contractor incurs in providing any such gratuities to any such officer or employee.

#### SC-19.05 **Small, Minority and Women's Businesses**

- A. If Contractor intends to let any subcontracts for a portion of the work, Contractor must take all necessary affirmative steps to assure that minority businesses, women's business enterprises, and labor surplus area firms are used whenever possible. Affirmative steps will include:
  - (1) Placing qualified small and minority businesses and women's enterprises on solicitation lists.
  - (2) Assuring that small and minority businesses; and women's business enterprises are solicited whenever they are potential sources.
  - (3) Dividing total requirements when economically feasible, into small tasks or quantities to permit maximum participation by small, minority, and women's business enterprises.
  - (4) Establishing delivery schedules, where the requirement permits, which encourage participation by small and minority businesses, and women's business enterprises
  - (5) Using the services and assistance, as appropriate, of such organizations as the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.

#### SC-19.06 **Anti-Kickback**

- A. Contractor shall comply with the Copeland Anti-Kickback Act (40 U.S.C. 3145) as supplemented by Department of Labor regulations (29 CFR Part 3, "Contractors and Subcontractors on Public Buildings or Public Works Financed in Whole or in Part by Loans and Grants from the United States"). The Act provides that

Contractor, or subcontractor must be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, to give up any part of the compensation to which he or she is otherwise entitled. Owner shall report all suspected or reported violations to Agency.

**SC-19.07 Clean Air Act and the Federal Water Pollution Control Act**

- A. Contractor to agree to comply with all applicable standards, orders or regulations issued pursuant to the Clean Air Act (42 U.S.C. 7401-7671q) and the Federal Water Pollution Control Act as amended (33 U.S.C. 1251-1387). Violations must be reported to the Federal awarding agency and the Regional Office of the U.S. Environmental Protection Agency (USEPA).

**SC-19.08 Equal Employment Opportunity**

- A. A. The Contract is considered a federally assisted construction contract. Except as otherwise provided under 41 CFR Part 60, all contracts that meet the definition of “federally assisted construction contract” in 41 CFR Part 60-1.3 must include the equal opportunity clause provided under 41 CFR 60-1.4(b), in accordance with Executive Order 11246, “Equal Employment Opportunity” (30 CFR 12319, 12935, 3 CFR Part 1964-1965 Comp., p. 339), as amended by Executive Order 11375, “Amending Executive Order 11246 Relating to Equal Employment Opportunity,” and implementing regulations at 41 CFR Part 60, “Office of Federal Contract Compliance Programs, Equal Employment Opportunity, Department of Labor.”

**SC-19.09 Byrd Anti-Lobbying Amendment (31 U.S.C. 1352)**

- A. Contractors that apply or bid for an award exceeding \$100,000 must file the required certification (RD Instruction 1940-Q, Exhibit A-1). The Contractor certifies to the Owner and every subcontractor certifies to the Contractor that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a member of Congress, officer or employee of Congress, or an employee of a member of Congress in connection with obtaining the Contract if it is covered by 31 U.S.C. 1352. The contractor and every subcontractor must also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the Owner. Necessary certification and disclosure forms shall be provided by Owner.

**SC-19.10 Environmental Requirements**

When constructing a Project involving trenching and/or other related earth excavations, Contractor shall comply with the following environmental conditions:

- A. **Wetlands** - When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert wetlands.

- B. **Floodplains** - When disposing of excess, spoil, or other construction materials on public or private property, Contractor shall not fill in or otherwise convert 100-year floodplain areas (Standard Flood Hazard Area) delineated on the latest Federal Emergency Management Agency Floodplain Maps, or other appropriate maps, e.g., alluvial soils on NRCS Soil Survey maps.
- C. **Historic Preservation** -Applicants shall ensure that Contractors maintain a copy of the following inadvertent discovery plan onsite for review:
1. If during any ground disturbance related to any Project, any post review discovery, including but not limited to, any artifacts, foundations, or other indications of past human occupation of the area are uncovered, shall be protected by complying with 36 CFR800.13(b)(3)and (c) and shall include the following:
    - a) All Work, including vehicular traffic, shall immediately stop within a 50 ft. radius around the area of discovery. The Contractor shall ensure barriers are established to protect the area of discovery and notify the Engineer to contact the appropriate RD personnel. The Engineer shall engage a Secretary of the Interior (SOI) qualified professional archeologist to quickly assess the nature and scope of the discovery; implement interim measures to protect the discovery from looting and vandalism; and establish broader barriers if further historic and/or precontact properties, can reasonably be expected to occur.
    - b) The RD personnel shall notify the appropriate RD environmental staff member, the Federal Preservation Officer (FPO), and State Historic Preservation Office (SHPO) immediately. Indian Tribe(s) that have an interest in the area of discovery shall be contacted immediately. The SHPO may require additional tribes who may have an interest in the area of discovery also be contacted. The notification shall include an assessment of the discovery provided by the SOI qualified professional archeologist.
    - c) When the discovery contains burial sites or human remains, the Contractor shall immediately notify the appropriate RD personnel who will contact the RD environmental staff member, FPO, and the SHPO. The relevant law enforcement authorities shall be immediately contacted by onsite personnel to reduce delay times, in accordance with tribal, state and local laws including 36 CFR Part 800.13; 43 CFR Part 10, Subpart B; and the Advisory Council on Historic Preservation’s Policy Statement Regarding treatment of Burial Sites, Human Remains, or Funerary Objects (February 23, 2007).
    - d) When the discovery contains burial sites or human remains, all construction activities, including vehicular traffic shall stop within a 100 ft. radius of the discovery and barriers shall be established. The evaluation of human remains shall be conducted at the site of discovery by a SOI qualified professional. Remains that have been removed from their primary context and where that context may be in question may be

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retained in a secure location, pending further decisions on treatment and disposition. RD may expand this radius based on the SOI professional's assessment of the discovery and establish broader barriers if further subsurface burial sites, or human remains can reasonably be expected to occur. RD, in consultation with the SHPO and interested Tribes, shall develop a plan for the treatment of native human remains.

- e) Work may continue in other areas of the undertaking where no historic properties, burial sites, or human remains are present. If the inadvertent discovery appears to be a consequence of illegal activity such as looting, the onsite personnel shall contact the appropriate legal authorities immediately if the landowner has not already done so.
- f) Work may not resume in the area of the discovery until a notice to proceed has been issued by RD. RD shall not issue the notice to proceed until it has determined that the appropriate local protocols and consulting parties have been consulted.
- g) Inadvertent discoveries on Federal and Tribal land shall follow the processes required by the Federal or Tribal entity.

D. **Endangered Species** - Contractor shall comply with the Endangered Species Act, which provides for protection of endangered and/or threatened species and critical habitat. Should any evidence of the presence of endangered and/or threatened species or their critical habitat be brought to the attention of Contractor, Contractor will immediately report this evidence to Owner and a representative of Agency. Construction shall be temporarily halted pending the notification process and further directions issued by Agency after consultation with the U.S. Fish and Wildlife Service.

E. **Mitigation Measures** - The following environmental mitigation measures are required on this Project:

- 1. See Specification Section 01500

**SC-19.11 Contract Work Hours and Safety Standards Act (40 U.S.C. 3701-3708)**

A. Where applicable, for contracts awarded by the Owner in excess of \$100,000 that involve the employment of mechanics or laborers, the Contractor must comply with 40 U.S.C. 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 U.S.C. 3702 of the Act, the Contractor must compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 U.S.C. 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous or dangerous. These requirements do not apply to purchases of supplies or

materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

**SC-19.12 Debarment and Suspension (Executive Orders 12549 and 12689)**

- A. A contract award (see 2 CFR 180.220) must not be made to parties listed on the government wide exclusions in the System for Award Management (SAM), in accordance with the OMB guidelines at 2 CFR 180 that implement Executive Orders 12549 (3 CFR Part 1986 Comp., p. 189) and 12689 (3 CFR Part 1989 Comp., p. 235), "Debarment and Suspension." SAM Exclusions contains the names of parties debarred, suspended, or otherwise excluded by agencies, as well as parties declared ineligible under statutory or regulatory authority other than Executive Order 12549.

**SC-19.13 Procurement of Recovered Materials**

- A. The Contractor must comply with 2 CFR Part 200.322, "Procurement of recovered materials."

**SC-19.14 Domestic Preference**

- A. **Build America, Buy America Act (BABA).** All Iron and Steel Products, Manufactured Products, and Construction Materials used in this project must comply with the Build America, Buy America Act (BABA) requirements mandated by Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, §§ 70901-70953. Aggregates such as stone, sand, or gravel do not apply to BABAA
- B. The following waivers apply to this Contract:
1. BABA De Minimis, Small Grants and Minor Components

**SC-19.15 Telecommunications and Video Surveillance Services or Equipment Prohibitions**

- C. The telecommunication and video surveillance services and equipment prohibitions under 2 CFR 200.216 apply to this contract. This contract may not be used to procure or obtain equipment, services, or systems that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. Covered telecommunications equipment is:
1. Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).
  2. Video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).
  3. Telecommunications or video surveillance services provided by such entities or using such equipment.
  4. Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the

Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

*Add the following new Article 20:*

#### **ARTICLE 20—PROJECT SIGN**

##### **SC-20.01 Construction Project Sign**

- A. Contractor will place a temporary construction project sign at a location designated by the Engineer. The sign will measure 4' x 8', will be made of 3/4" exterior grade plywood and adhere to the format and details given on the sheet at the end of this section. The sign will be prepared by a professional sign maker.

*Add the following new Article 21:*

#### **ARTICLE 21—CALIFORNIA STATE REQUIREMENTS**

##### **SC-21.01 Registration with the California Department of Industrial Relations**

- A. This project is a "public works" project as defined in California Labor Code Section 1720 through 1743. In accordance with California Labor Code Article 1725.5, Contractor and all subcontractors are required to be registered with the California Department of Industrial Relations (DIR) in order to bid or be listed on a bid and/or work on a public works project.

##### **SC-21.02 Antitrust Claim Settlement**

- A. In entering into a public works contract or a subcontract to supply goods, services, or materials pursuant to a public works contract, the Contractor or Subcontractor offers and agrees to assign to the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 15) or under the Cartwright Act (Chapter 2 (commencing with Section 16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services, or materials pursuant to the public works contract or the subcontract. This assignment shall be made and become effective at the time the awarding body tenders final payment to the Contractor, without further acknowledgment by the parties.

##### **SC-21.02 Utilities**

- A. Contractor shall be responsible for marking all excavations and notifying Underground Service Alert (USA) at least 48 hours before digging and follow all other provisions of California Government Code Sections 4216 through

4216.9. Contractor shall maintain an active USA ticket number for the entire duration of the excavation.

- B. Unless otherwise indicated in the Contract Documents, all utility lines, conduits, wires, or structures shall be maintained by the Contractor and shall not be disturbed, disconnected, or damaged by him during the progress of the Work, provided, that should the Contractor in the performance of the Work disturb, disconnect, or damage any of the above, all expenses arising from such disturbance or in the replacement or repair thereof shall be borne by the Contractor. However, in accordance with Section 4215 of the California Government Code, the Contractor shall be compensated for all costs of locating and repairing damage to main or trunkline utility facilities located on the work site and for costs of operating equipment on the work site necessarily idled during such work where the Contractor has exercised reasonable care in removing or relocating utility facilities which are inaccurately indicated in the Contract Documents.

**EXHIBIT A—SOFTWARE REQUIREMENTS FOR ELECTRONIC DOCUMENT EXCHANGE**

<b>Item</b>	<b>Electronic Documents</b>	<b>Transmittal Means</b>	<b>Data Format</b>	<b>Note (1)</b>
a.1	General communications, transmittal covers, meeting notices and responses to general information requests for which there is no specific prescribed form.	Email	Email	
a.2	Meeting agendas, meeting minutes, RFI's and responses to RFI's, and Contract forms.	Email w/ Attachment	PDF	(2)
a.3	Contactors Submittals (Shop Drawings, "or equal" requests, substitution requests, documentation accompanying Sample submittals and other submittals) to Owner and Engineer, and Owner's and Engineer's responses to Contractor's Submittals, Shop Drawings, correspondence, and Applications for Payment.	Email w/ Attachment	PDF	
a.4	Correspondence; milestone and final version Submittals of reports, layouts, Drawings, maps, calculations and spreadsheets, Specifications, Drawings and other Submittals from Contractor to Owner or Engineer and for responses from Engineer and Owner to Contractor regarding Submittals.	Email w/ Attachment or LFE	PDF	
a.5	Layouts and drawings to be submitted to Owner for future use and modification.	Email w/ Attachment or LFE	DWG	
a.6	Correspondence, reports and Specifications to be submitted to Owner for future word processing use and modification.	Email w/ Attachment or LFE	DOC	
a.7	Spreadsheets and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	EXC	
a.8	Database files and data to be submitted to Owner for future data processing use and modification.	Email w/ Attachment or LFE	DB	
<b>Notes</b>				
(1)	All exchanges and uses of transmitted data are subject to the appropriate provisions of Contract Documents.			
(2)	Transmittal of written notices is governed by Paragraph 18.01 of the General Conditions.			
<b>Key</b>				
Email	Standard Email formats (.htm, .rtf, or .txt). Do not use stationery formatting or other features that impair legibility of content on screen or in printed copies			
LFE	Agreed upon Large File Exchange method (FTP, CD, DVD, hard drive)			
PDF	Portable Document Format readable by Adobe® Acrobat Reader			
DWG	Autodesk® AutoCAD .dwg format			

DOC	Microsoft® Word .docx format
EXC	Microsoft® Excel .xls or .xml format
DB	Microsoft® Access .mdb format

**EXHIBIT B—FORESEEABLE BAD WEATHER DAYS**

Month	Number of Foreseeable Bad Weather Days in Month Based on Precipitation as Rain Equivalent (inches) (1)	Ambient Outdoor Air Temperature (degrees F)	
		Number of Foreseeable Bad Weather Days in Month Based on Low Temperature (at 11:00 a.m.)	Number of Foreseeable Bad Weather Days in Month Based on High Temperature (at 3:00 p.m.)
January	11	0	0
February	10	0	0
March	9	0	0
April	6	0	0
May	3	0	0
June	1	0	0
July	0	0	0
August	0	0	0
September	1	0	0
October	4	0	0
November	8	0	0
December	10	0	0

**Notes:**

1. Two inches of sleet equal one inch of rain. Five inches of wet, heavy snow equal one inch of rain. Fifteen inches of “dry” powder snow equals one inch of rain.

**BUILD AMERICA, BUY AMERICA ACT (BABA)**  
**COMPLIANCE REQUIREMENTS**  
USDA Rural Development

This project is subject to the USDA Rural Development Build America, Buy America Act (BABA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Pub. L. 117-58, Sections 70901- 70953. Absent an approved waiver, all Iron & Steel, Manufactured Products and Construction Materials used in this project must be produced in the United States. The following waivers apply to this project: BABA De Minimis, Small Grants, and Minor Components.

**COMPLIANCE STEPS**

1. Manufacturer's Certification Letters are to be used to verify compliance with the BABA requirements. The Manufacturer's Certifications shall be included in the product and material submittals to the Engineer. A Sample Manufacturer's Certification Letter is attached.
  
2. Installation of materials that are non-compliant with BABA requirements shall be considered defective work. Contractor should ensure that the Engineer has been provided an approved Manufacturer's Certification, or approved waiver, prior to any domestic compliant item being delivered to the project site.
  
3. A project file containing a listing of all items used in the project subject to BABA and their corresponding certification letters must be kept by the Contractor and Engineer and maintained throughout the course of the project.
  
4. The De Minimis Waiver which allows the use of a minor amount of non-domestic items applies to this project. This waiver allows the use of non-domestic items up to 5% of the project cost with a maximum of \$1,000,000. The Contractor will be required to maintain an itemized listing of these items. A sample format for documenting the use of De Minimis items is attached.
  
5. Contractor shall submit a completed Contractor's Certification to the Engineer upon Substantial Completion to certify that all iron and steel products, manufactured products, and construction materials installed for this project complied with BABA requirements. Sample Language for the Contractor's Certification is attached.

6. Upon Project Completion, the Engineer shall provide copies of the following items to both the Owner and USDA Rural Development:

- a. Manufacturer's Certification Letters of products used in the project.
- b. Contractor's Certification Letter of the project compliance with BABA.
- c. Documentation of Compliance with the De Minimis Waiver.

## DEFINITIONS

**Domestic Preference** - The USDA Rural Development Build America, Buy America Act (BABA) requirements.

**Build America, Buy America Act (BABA)** - Requirements mandated by Title IX of the Infrastructure Investment and Jobs Act (IIJA), Public Law 117-58, Sections 70901-70953 mandating domestic preference that all Iron and Steel Products, Manufactured Products, and Construction Materials are produced in the United States.

**Iron and Steel Product** - A product that is greater than 50 percent iron or steel on a materials cost basis unless another standard applies under law or regulation. Examples of an iron and steel product include but are not limited to lined or unlined pipe, fittings, manhole covers and other municipal castings.

**Manufactured Product** - Items assembled out of components, or otherwise made or processed from raw materials into finished products. Manufactured products must be manufactured (assembled) in the United States, and the cost of components that were mined, produced, or manufactured in the United States must be greater than 55 percent of the total cost of all components of the product. An example is a valve that does not meet the definition of an iron and steel product (does not have greater than 50 percent iron and steel) but could be considered a manufactured product.

**Construction Materials** – Includes articles, materials, or supplies that are non-ferrous metals, plastic and polymer-based products (PVC, composite building materials, polymers used in fiber optic cables), glass (including optic glass), lumber, and drywall.

Does not include iron and steel products or manufactured products; cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives.

**Engineer's Certification** - Document submitted by the Engineer that certifies that the project Drawings, Specifications, and Bidding Documents comply with BABA requirements.

**Manufacturer's Certification** - Document provided by the Manufacturer that certifies that BABA requirements have been satisfied for all provided items. If a Supplier, Distributor, Vendor or other entity purchase the items directly from a Manufacturer, then they will be responsible for obtaining and providing the Manufacturers Certifications to the purchaser of the products.

**Contractor's Certification** - Document submitted by the Contractor upon Substantial Completion of the Contract that all Iron and Steel Products, Manufactured Products, and Construction Materials used in the project were produced in the United States or were used under an approved waiver.

**De Minimis Waiver**- Materials and Products that represent a small portion of an infrastructure project, specifically no more than 5% of the total project cost up to a maximum of \$1,000,000.

## MANUFACTURER'S CERTIFICATION OF COMPLIANCE

Build America, Buy America Act (BABA)

USDA Rural Development

*NOTE: This exhibit provides sample language for the Manufacturer's Certification of Compliance with USDA Rural Development BABA requirements. Contractor should ensure that the Engineer has an approved Manufacturer's Certification prior to any domestic preference item being delivered to the project site. The Manufacturer's Certification should be on letterhead and should indicate the project, the specific item(s) being certified, reference the Build America, Buy America Act and be signed by an authorized company representative.*

Date

Company Name

Company Address

Subject: BABA Requirement Certification

Owner's Name

Project Name

Project Location (City, State)

I hereby certify that the following Products(s) and/or Material(s) shipped or provided for the subject project are in full compliance with the USDA Rural Development Build America, Buy America Act (BABA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Public Law 117-58, Sections 70901-70953.

{List common names of items, products and/or materials}

Authorized Representative

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(Signature)

## CONTRACTOR'S CERTIFICATION OF COMPLIANCE

Build America, Buy America Act (BABA)

USDA Rural Development

*NOTE: This exhibit provides sample language that the Contractor can use to certify compliance with the USDA Rural Development Build America, Buy America Act (BABA) requirements. A certification is to be provided by Contractor to the Engineer for delivery to the Owner and USDA Rural Development at Substantial Completion. The certification should be on letterhead and be signed by an authorized company representative.*

Date

Owner Name

Project Name

Project Location (City, State)

I hereby certify that to the best of my knowledge and belief, all Iron and Steel Products, Manufactured Products, and Construction Materials installed for this project by my company and by all subcontractors and manufacturers my company has contracted with for this project comply the USDA Rural Development Build America, Buy America Act (BABA) requirements under Title IX of the Infrastructure Investment and Jobs Act (IIJA), Public Law 117-58, Sections 70901-70953. or are the subject of a waiver approved by the Secretary of Agriculture or designee.

Company Name

Authorized Representative

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(Signature)

**DE MINIMIS WAIVER FORM**

Build America, Buy America Act (BABA)

USDA Rural Development

*NOTE: This exhibit is an example format for Contractors to use in maintaining a list of items to document the use of the De Minimis Waiver of the Domestic Preference requirements. This type of list is required to be filled out throughout the construction contract as needed. USDA Rural Development may periodically ask to review this information. At the contract completion, this list, along with all manufacturers ' certifications, are to be given to the Engineer for delivery to the Owner and USDA Rural Development.*

**DE MINIMIS COST WORKSHEET**

Owner: \_\_\_\_\_

Project Name: \_\_\_\_\_

Contractor: \_\_\_\_\_

Representative: \_\_\_\_\_

Date: \_\_\_\_\_

Total Project Cost: \$ \_\_\_\_\_

Allowable Total De Minimis Costs (5% of total project cost): \$ \_\_\_\_\_

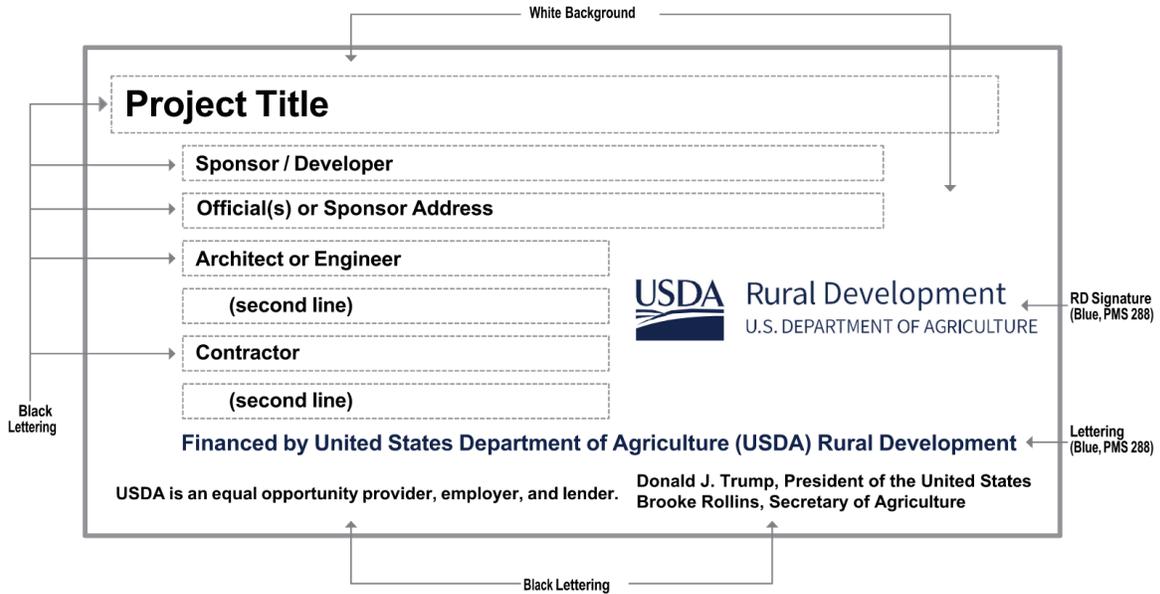
Total Cost of all Listed De Minimis Items: \$ \_\_\_\_\_

Remaining Amount Allowed for Future De Minimis Items \$ \_\_\_\_\_

No.	De Minimis Item		Quantity	Cost Per Item	Total Item Cost
	Description	Manufacturer/Source			
1					
2					
3					

# TEMPORARY CONSTRUCTION SIGN FOR RURAL DEVELOPMENT PROJECTS

Recommended Fonts: Helvetica or Arial



**SIGN DIMENSIONS** : 1200 mm x 2400 mm x 19 mm (approx. 4' x 8' x 3/4")  
PLYWOOD PANEL (APA RATED A-B GRADE-EXTERIOR)

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# CALIFORNIA STATE REQUIREMENTS

## **CA-1.01 Utilities**

- A. Contractor shall be responsible for marking all excavations and notifying Underground Service Alert (USA) at least 48 hours before digging and follow all other provisions of California Government Code Sections 4216 through 4216.9. Contractor shall maintain an active USA ticket number for the entire duration of the excavation.
- B. Unless otherwise indicated in the Contract Documents, all utility lines, conduits, wires, or structures shall be maintained by the Contractor and shall not be disturbed, disconnected, or damaged by him during the progress of the Work, provided, that should the Contractor in the performance of the Work disturb, disconnect, or damage any of the above, all expenses arising from such disturbance or in the replacement or repair thereof shall be borne by the Contractor. However, in accordance with Section 4215 of the California Government Code, the Contractor shall be compensated for all costs of locating and repairing damage to main or trunkline utility facilities located on the work site and for costs of operating equipment on the work site necessarily idled during such work where the Contractor has exercised reasonable care in removing or relocating utility facilities which are inaccurately indicated in the Contract Documents.

## **CA-1.02. Worker Protection-Excavations**

For all excavations in excess of five (5) feet, the Contractor shall, pursuant to Labor Code Section 6705, submit in advance of any excavation hereunder a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from caving ground. No such excavation shall be made until said detailed plan is submitted by Contractor and accepted by Engineer.

## **CA-1.03 Registration with the California Department of Industrial Relations**

This project is a "public works" project as defined in California Labor Code Section 1720 through 1743. In accordance with California Labor Code Article 1725.5, Contractor and all subcontractors are required to be registered with the California Department of Industrial Relations (DIR) in order to bid or be listed on a bid and/or work on a public works project.

## **CA-1.04 Claims**

If this is a "Public Works Contract" as defined in Section 22200 of the California Public Contract Code, claims shall be resolved pursuant to Section 9204 of the California Public Contract Code. Key provisions of that section are summarized as follows:

1. "Claim" means a separate demand by a contractor sent by registered mail or certified mail with return receipt requested, for one or more of the following:

- (A) A time extension, including, without limitation, for relief from damages or penalties for delay assessed by a public entity under a contract for a public works project.
  - (B) Payment by the public entity of money or damages arising from work done by, or on behalf of, the contractor pursuant to the contract for a public works project and payment for which is not otherwise expressly provided or to which the claimant is not otherwise entitled.
2. Payment of an amount that is disputed by the public entity upon receipt of a claim pursuant to this section, Owner shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide Contractor a written statement identifying what portion of the claim is disputed and what portion is undisputed. Upon receipt of a claim, Owner and Contractor may, by mutual agreement, extend the time period provided in this subdivision.
  3. Contractor shall furnish reasonable documentation to support the claim.
  4. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after Owner issues its written statement.
  5. If Contractor disputes Owner's written response, or if Owner fails to respond to a claim, Contractor may demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand in writing sent by registered mail or certified mail, return receipt requested, Owner shall schedule a meet and confer conference within 30 days for settlement of the dispute.
  6. Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, Owner shall provide Contractor a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after Owner issues its written statement. Any undisputed portion of the claim, as identified by the Contractor in writing, shall be submitted to nonbinding mediation with the public entity and Contractor sharing the associated costs equally. If the mediation is unsuccessful, the parts of the claim remaining in dispute shall be subject to applicable procedures outside this section.
  7. Failure by Owner to respond to a claim from Contractor within the time periods described herein or to otherwise meet the time requirements of this section shall result in the claim being rejected in its entirety. A claim that is denied by reason of the public entity's failure to have responded to a claim, or its failure to otherwise meet the time requirements of this section, shall not constitute an adverse finding with regard to the merits of the claim or the responsibility or qualifications of the claimant.
  8. Amounts not paid in a timely manner as required by this section shall bear interest at the maximum legal rate.

#### **CA-1.05 Antitrust Claim Settlement**

In entering into a public works contract or a subcontract to supply goods, services, or materials pursuant to a public works contract, the Contractor or Subcontractor offers and agrees to assign to the awarding body all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15

U.S.C. Section 15) or under the Cartwright Act (Chapter 2 (commencing with Section 16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services, or materials pursuant to the public works contract or the subcontract. This assignment shall be made and become effective at the time the awarding body tenders final payment to the Contractor, without further acknowledgment by the parties.

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**WORK CHANGE DIRECTIVE NO.: \_\_\_\_\_**

Owner: Calaveras County Water District

Owner's Project No.: 15095

Engineer: HydroScience Engineers

Contractor:

Contractor's Project No.:

Project: Arnold WWTF Phase I  
Improvements

Contract Name:

Date Issued:

Effective Date of Work Change Directive:

Contractor is directed to proceed promptly with the following change(s):

Description:

Attachments:

Purpose for the Work Change Directive:

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Non-agreement on pricing of proposed change.  Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price: \$ \_\_\_\_\_ [increase] [decrease] [not yet estimated].

Contract Time: \_\_\_\_\_ days [increase] [decrease] [not yet estimated].

Basis of estimated change in Contract Price:

Lump Sum  Unit Price  Cost of the Work  Other

Recommended by Engineer

Authorized by Owner

By:

\_\_\_\_\_

\_\_\_\_\_

Title:

\_\_\_\_\_

\_\_\_\_\_

Date:

\_\_\_\_\_

\_\_\_\_\_

CIP 15095  
Arnold WWTF Phase I Improvements Project

00940-1

Work Change Directive  
June 25

EJCDC® C-940, Work Change Directive.

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**SECTION 01010  
SUMMARY OF WORK**

**PART 1 - GENERAL**

**1.01 Summary**

A. The work to be done consists of furnishing all labor, materials, equipment, services, supplies, and manufactured articles and furnishing all labor, transportation, and services, including fuel, power, water and essential communications, and performing all work, or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The Work shall be complete, and all materials, and services not expressly indicated or called for in the Contract Documents which are necessary for the complete and proper construction of the Work in good faith shall be provided by the Contractor as though originally so indicated, at no increase in cost to the Owner.

**1.02 Project Site Conditions**

<b>Item</b>	<b>Description</b>
Location	Arnold, CA.
Site Address	3294 Highway 4, Arnold, California 95223
Elevation	Approximately 4,000 feet
Ambient Temperatures	Annual Average Low = 27°F (January) Annual Average High = 83°F (July)

**1.03 Contractor Scope of Services:**

- A. The work comprises furnishing all labor, materials, equipment (unless otherwise excluded under "Owner Pre-purchased Equipment"), and services for the Project, of which the Work under the Contract Documents is a part, is generally described as follows: Furnishing all labor, materials, equipment and services for the new secondary clarifier with new effluent pump, new metering and flow splitting structures, replacement Return Activated Sludge and Waste Activated Sludge (RAS/WAS) pump station, two additional aerobic digesters with motorized mixers, new digester blowers installed in the existing building, new electrical and control building with new motor control center and master control panel, upgraded PG&E power service, new generator, and associated improvements to yard piping, grading, paving, power and control conduit and wiring, instrumentation, and PLC/SCADA controls. The work involves upgrading an existing wastewater treatment process and complete replacement of the electrical and control system for that facility. Careful sequencing and coordination of the work in accordance with contract requirements and best practices will be required to maintain existing facility operations and avoid unplanned interruptions.
- B. Facilities required for substantial completion include, but are not limited to: water, materials, machinery, underground yard piping, utility vaults, concrete structures, clarifier equipment and appurtenances, pumps, digester mixers, blowers, supports, mechanical devices, instrumentation, level controls, standby generator, electrical services, mechanical valves and appurtenances, site and access road pavement, drainage systems, site lighting, pump and electrical housekeeping pads, above ground piping, valves, flow meters, process instrumentation, main switch board, motor control center, master control panel, low voltage control and instrumentation wiring, site drainage, finish grading, gravity retaining wall, aggregate base, and all miscellaneous work as shown and

specified for the full start-up and operation of all treatment facility improvements. Successful start-up and commissioning is also included in the substantial completion requirements.

**1.04 Owner Scope of Services (Not Used)**

**1.05 Owner Pre-purchased Equipment (Not Used)**

**1.06 Work Included**

- A. The Contractor shall furnish all labor, superintendence, materials, power, light, heat, fuel, water, tools, appliances, equipment, supplies, services, and other means of construction necessary or proper for performing and completing the work.
- B. The Contractor shall obtain and pay for all required permits.
- C. Contractor shall perform and complete the work in the manner best calculated to promote rapid construction consistent with safety of life and property, to the satisfaction of the Owner's Representative and in strict accordance with the Contract Documents.
- D. The Contractor shall clean up the work site and maintain it during and after construction, until accepted, and shall do all of the work and pay all costs incidental thereto.
- E. The Contractor shall repair all structures and property that may be damaged or disturbed during performance of the work.
- F. The Contractor shall provide and maintain such modern plant, tools, and equipment as may be necessary to perform in a satisfactory and acceptable manner all the work required by this Contract. Only equipment of established reputation and proven efficiency shall be used. The Contractor shall be solely responsible for the adequacy of his plant and equipment.
- G. The Work consists of the project elements summarized below and all additional work shown, specified, or otherwise required for a complete and operable installation:

**1. Treatment Process Upgrades:**

- a. New Mixed Liquor Metering and Flow Splitting Facilities:
  - 1) Complete all required excavation, shoring, and backfill.
  - 2) Install concrete vault structures.
  - 3) Furnish and install pipe, flowmeters, control valves, weirs, pipe supports, hatches and grating, valves, and appurtenances.
  - 4) Make required piping, power, and controls tie-ins.
- b. New Secondary Clarifier and Effluent Pump Station:
  - 1) Complete all required excavation, shoring, and backfill.
  - 2) Install concrete tank structure.
  - 3) Furnish and install clarifier mechanism, drive, weirs and baffles, collectors, bridge platform with stairs, effluent pump, pump supports, piping, grating, valves, and appurtenances.
  - 4) Make required piping, power, and controls tie-ins.
  - 5) Test and commission the clarifier, pump station, and associated metering and flow splitting structures.
- c. New Sludge Digesters:
  - 1) Complete all required excavation, shoring, and backfill.

- 2) Install concrete tank structures.
  - 3) Furnish and install mixers, diffuser assemblies, telescoping valves, inlet and outlet piping, valves and appurtenances, access platforms, handrailing, and stairs.
  - 4) Make required piping, power, and controls tie-ins.
  - 5) Test and commission the new digesters.
- d. Existing Sludge Digesters
- 1) Replace existing diffusers.
- e. New Digester Blowers
- 1) Remove existing 55 kw emergency generator from existing Control Building. Turn over to District or demolish at District's sole discretion.
  - 2) Remove, cap, and abandon existing LPG gas line.
  - 3) Remove engine intake and exhaust louvers and cap/plug openings as shown.
  - 4) Prepare and extend existing concrete slab as shown.
  - 5) Furnish and install new positive displacement blower units, discharge piping, silencers, flexible joints, and appurtenances.
  - 6) Test and commission new blower units.
- f. RAS/WAS Pump Station:
- 1) Install concrete equipment pad.
  - 2) Furnish and install positive displacement pumps and appurtenances, valves, instrumentation, above and below grade piping.
  - 3) Make required piping, power, and controls tie-ins.
  - 4) Test and commission the pumping facility.

## **2. New Control Building:**

- a. Construct CMU utility building on concrete foundation with wood truss standing seam metal roof.
- b. Install sidewalks, drainages, and gravity retaining wall as shown.
- c. Install electrical and control equipment, power and lighting, air conditioning, embedded and exposed conduit, and wiring as shown.

## **3. Electrical**

- a. After all loads are transferred over to the new service, demolish existing PG&E transformer, existing service pole, wiring and related components.
- b. Install new irrigation termination panel to extend signals to MCP in new building.
- c. Install new PG&E transformer pad, raceways, main switchboard and metering panel, motor control center, wiring, earthwork, and related tasks.
- d. Coordinate with PG&E for placing transformer and energization.
- e. Install buried ductbanks, junction boxes, and wiring to all existing and new loads and instruments.

## **4. Master Control Panel**

- a. Furnish and install new master control panel with main PLC, I/O, uninterruptible power supply, modem, and all other features shown and specified. This new control panel will completely replace the existing control system.
- b. Coordinate with the Owner's controls programmer.
- c. Connect control wiring from all existing and new equipment and instrumentation.
- d. After commissioning the new control system, decommission and remove existing master control panel in the existing Control Building.

**5. Yard Structures:**

- a. Includes piping structures including concrete pads, civil structures, underground vaults, electrical and control handholes, electrical equipment foundations.

**6. Yard Piping and Process Piping**

- a. Includes excavation, dewatering, flow bypassing, temporary piping/valves, piping, valves, and fittings, pipe stubs, tie-ins of new piping to existing piping, existing pipe taps, backfilling and testing.

**7. Site Work**

- a. Includes excavation, dewatering, bypassing, backfill, earthwork, rough and finished grading, and site lighting.

**8. Pavement**

- a. Includes asphalt, gravel, and aggregate base paving, concrete sidewalks, and finished surfacing.

**9. Acceptance Testing and Demonstration**

- a. Includes all labor, materials and equipment required for implementation of comprehensive factory and site acceptance testing and demonstration as shown and specified.

**10. Demolition and Abandonment**

- a. Includes demolition and removal of trees, large rocks, existing RAS pump station, existing mixed liquor flow control equipment and vault, existing above and below grade piping and appurtenances, existing motor control center and control panel, existing standby generator, and other items as shown and specified.
- b. Where shown, includes abandonment in place (capping, filling, etc. as shown) of buried yard piping.

H. Except as Specifically Noted Otherwise, Contractor will provide and pay for:

1. Insurance and bonds.
2. Labor, materials, and equipment.
3. Tools, equipment, and machinery required for construction.
4. Utilities required for construction.
5. Temporary facilities including dewatering, sheeting and shoring.
6. Traffic control and dust control measures.
7. Other facilities and services necessary for proper execution and completion of the Work.
8. Secure and pay for all permits including OSHA excavation permits, dewatering, Department of Transportation permits, government fees, and licenses.

9. Comply with codes, ordinances, regulations, orders, and other legal requirements of public authorities having bearing on the performance of the Work.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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# SECTION 01014 WORK SEQUENCE

## PART 1 - GENERAL

### 1.01 Summary

- A. Section includes requirements, constraints and limitations on the sequence and scheduling of Work required to complete the project affected by site conditions, construction, and plant operations.
- B. Related Sections

<u>Section</u>	<u>Title</u>
Section 01010	Summary of Work
Section 01311	Scheduling and Reporting

### 1.02 General Constraints on Work Sequence

- A. The Contractor shall keep the Owner's Representative fully advised as to plans for carrying out the work and obtain the Owner's Representative's approval for all phases of construction operations, as hereinafter specified.
- B. The existing wastewater facilities are currently and continuously in use and shall not be interrupted except as specified herein and only in accordance with a detailed Outage Plan that has been approved by the Owner's Representative in advance of the work.
- C. The Contractor shall coordinate the work to avoid any interference with normal operation of the wastewater facilities.

### 1.03 Outage Plan

- A. The Contractor shall submit a detailed outage plan and time schedule for operations that will make it necessary to remove any pipeline, channel, electrical circuit, equipment, or structure from service. The schedule shall be coordinated with the construction schedule specified in Section 01311-Scheduling and Reporting and shall meet the restrictions and conditions specified in this Section.
- B. The Contractor shall observe the following requirements:
  - 1. Systems or individual equipment items shall be isolated, dewatered, decommissioned, de-energized, or depressurized in accordance with the detailed outage plan and schedule. The Owner's Representative shall be notified in writing at least one week, or as specified below, in advance of the planned operation.
  - 2. Whenever the construction work requires dewatering or bypassing portions of the facilities, the Contractor shall provide the necessary pumping and bypassing facilities to maintain the water flow. The Outage Plan schedule of activities shall fully account for the effort and duration required to dewater facilities as part of the outage activity.
  - 3. Whenever temporary relocation of existing facilities is required for execution of the work, the Contractor shall provide the necessary labor and temporary piping and wiring as required.
  - 4. Any temporary facilities and equipment not required after completion of the final work shall be promptly removed.
  - 5. When shutdown of any existing facilities is necessary, the Contractor shall notify the Owner's Representative not less than 14 days prior to the shutdown.

6. The Contractor shall not begin an alteration until specific permission has been granted by the Owner's Representative in each case. The Owner's Representative will coordinate the Contractor's planned procedure with the operation of the system. The making of connections to existing facilities or other operations that interfere with the operation of the existing equipment shall be completed as quickly as possible and with as little delay as possible.
7. The Owner's Representative will be the sole judge of when the Contractor's operations are causing interference with existing water and wastewater facilities, and the Owner's Representative's orders and instructions shall be carried out without delay.

#### **1.04 Existing Permits**

- A. The existing facility is operated under a permit issued by the California Valley Regional Water Quality Control Board.
  1. A copy of the permit is available for review at the plant.
  2. The permit specifies the water quality limits that this facility must meet prior to discharge or reuse of effluent.
- B. Perform work in such a manner as to not interfere with the ability of this facility to meet all permit requirements.
- C. Contractor shall bear the cost of any penalties imposed on the Owner for any discharge violations caused by the actions of the Contractor.

#### **1.05 Facility Limitations**

- A. The Contractor's master project schedule and outage plans must take into account facility limitations affecting the allowable duration, timing, and nature of partial and full interruptions of treatment operations.
- B. The existing facility is a wastewater treatment plant with a single process train. It is not possible to continue to treat wastewater at reduced flow when the existing clarifier or effluent pumps are offline given the lack of a second parallel process train. Therefore, all treatment flows must be stopped for process outages, and the incoming wastewater must be temporarily stored.
- C. The existing facility receives wastewater from existing collection system sewer lift stations. The collection system lacks upstream storage capacity; therefore, the sewer lift stations must be allowed to remain online to periodically pump wastewater to the existing treatment facility headworks in response to upstream collection system flows.
- D. When it is necessary to take the full treatment process (oxidation ditch, clarifier, and effluent pumping) offline, the operations staff achieves this by drawing down the liquid level in the oxidation ditch to its minimum level prior to the shutdown, and then closing mixed liquor valves downstream of the oxidation ditch to stop flow to clarification and effluent pumping. The available storage volume in the oxidation ditch between minimum and maximum levels is utilized to store incoming wastewater during the outage. The operations staff utilizes the upper zone of the ditch to perform settling in lieu of the clarifier and pumps the clarified water to the existing clarifier effluent pump wet well. The existing clarifier is then settled and the clear water manually pumped to filtration.
- E. Interruptions of the treatment process in accordance with approved Outage Plans are subject to the following limitations:
  1. No shutdowns permitted when measurable rainfall has occurred during the prior 48 hours or is predicted by the National Weather Service within the next three days.
  2. May – October: Maximum full outage duration of 12-14 hours during an average dry weather flow day or 6-8 hours during a maximum month flow day.

3. November – April: Outages not permitted.

- F. The maximum number of full treatment process interruptions shall be as few as possible, not to exceed a total of three. The minimum recovery time between full outages is two weeks. The maximum number of partial interruptions shall be as few as possible and subject to Owner's Representative approval.
- G. The disposal field irrigation valves can be operated manually during controls transitions. The maximum duration of automated valve control outage shall be two consecutive days.
- H. The allowable duration of a partial facility outage will be determined and provided by the District upon Contractor's request. Pump-arounds and local manual operations are possible during normal working hours, depending on the system or component involved.

### **1.06 Construction Sequencing and Constraints**

- A. The Contractor shall plan, schedule, and sequence the Work in conformance with the following constraints, conform to Paragraph 1.05 Facility Limitations, and as otherwise required to prevent unplanned impacts to ongoing wastewater treatment operations, avoid the potential for spills or overflows, and maintain the ability to comply with the facility discharge permit.
  - 1. Factory acceptance testing (FAT) and witness testing of electrical gear and programming with simulated inputs/outputs shall be conducted before the Main Switchboard (MSB), new Motor Control Center (MCC), and new Master Control Panel (MCP) leave the factory. The MCP factory acceptance testing shall be observed by owners representative and verification shall be made with control program to be provided by the system programmer to verify I/Os. Owners representatives shall be notified not less than one week prior to the scheduled factory acceptance testing is to be performed.
  - 2. New process equipment, powered devices, and instrumentation shall be interconnected with the new MCC and MCP.
  - 3. Existing process equipment, powered devices, and instrumentation that are currently connected to the existing MCC and MCP shall be transitioned to the new panels located in the new control building in a pre-planned stepwise manner after the new panels are in place, energized, programmed, and tested. Conduit and wire up to all new and existing devices shall be installed in advance of the cutovers, and the termination changes shall be made at the time of cutover. Simultaneous operation of both MCPs will be required until all signals are cutover to the new MCP.
  - 4. The new PG&E service must be energized prior to testing new process units or transitioning existing field devices to the new MCC and MCP located in the new control building.
  - 5. Temporary simultaneous energization of both PG&E services is possible at this site. The new transformer must be in place with conduits to new service section before PG&E will energize the new transformer. The contractor shall be responsible for providing all necessary trenching, conduit and backfilling from the existing PG&E J-Box(J-894) to the new transformer and to the service metering section in the Main Switchboard(MSB). All new service shall be coordinated with PG&E design requirements and the contractor shall coordinate all work and required inspections with the utility.
  - 6. The contractor shall provide the utility the opportunity to review the main switchboard metering section prior to any panels being ordered.
  - 7. The standby generator system (Genset) must be in place and fully tested and operational before cutover to new transformer.

8. All existing equipment and instrument loads are to be transferred from the existing MCC to the new MCC. The transfer of existing loads to the new MCC and length of time to complete the transfer of existing loads to the new MCC must be coordinated with the utility.
9. The existing Control Building lighting panels A and B are integral with the existing MCC. The existing utility service power energizes the existing ATS located in the adjacent section next to the panelboard sections. As 480VAC loads are transitioned from the existing MCC to the new MCC the sections that are no longer in use shall be deenergized and removed.

As the existing MCC sections are deenergized and removed new panelboards A and B shall be mounted on the newly available wall space. A horizontal wireway shall be installed and used to extend single phase power circuits.
10. The existing MCC and MCP shall be demolished after the new MCC and MCP are fully tested and operational with all field devices connected.
11. Construct and equip new process tanks, vaults, equipment pads, and Control Building adjacent to existing facilities as shown while existing facilities continue to operate uninterrupted.
12. Construct new buried yard piping up to tie-ins to existing piping but do not make those tie-ins until new processes and tanks are complete functional & leak testing and are ready to place into operation. Protect existing piping in-place including where crossing in-service piping that will later be demolished (for example, ML pipe between existing flow splitter box and existing clarifier).
13. The following pipes can be hot-tapped to reduce system outages (thrust blocks are required at all taps):
  - a. Existing digesters WAS, DSL, and DSN tie-ins
  - b. New effluent pump discharge SE pipe to existing SE pipe from existing effluent pumps
14. Tie new 8" ML into existing 6" ML Oxidation Ditch mixed liquor outlet pipe utilizing a tee tied into existing downstream 6" ML pipe so that existing flow path from oxidation ditch to existing clarifier through the existing flow metering facility can be temporarily maintained until new processes are online.
15. Tie new 4" RAS into existing buried RAS pipe utilizing a tee so that existing flow path from existing RAS/WAS Pump Station can be temporarily maintained until new processes are online.
16. The new Mixed Liquor Metering and Flow Splitting Facilities, Secondary Clarifier-2 (SC-2) and new effluent pump, and new RAS/WAS pump station must be commissioned together as they are part of a complete system.
17. Existing Secondary Clarifier-1 (SC-1) can be taken out of service for piping modifications after the new Mixed Liquor Metering and Flow Splitting Facilities, Secondary Clarifier-2 (SC-2) and new effluent pump, and new RAS/WAS pump station are tested and operating. However, the existing effluent pumps at SC-1 must remain in service at all times, except for a maximum 8-hour outage to complete 6" SE and 10" SE piping connections to the existing clarifier effluent pump wet well. Then this wet well and these pumps shall be placed back into operation, utilizing the 10" SE to transfer effluent from the SC-2 for pumping to the filters. SC-1 can remain offline for a longer duration for modifications.
18. The new blowers must be installed, tested, and ready for operation before the existing blower air supply piping to the Oxidation Ditch and Digesters is disconnected from the Digesters and the new air piping connected.
19. After completion of all work at the new digesters including testing and commissioning, the District can take the existing digesters offline and drain them so that the Contractor can replace the existing diffusers as shown.

20. After completion of Performance Testing (see Section 01660), decommission and demolish existing RAS/WAS pump station and existing mixed liquor metering facility. Contractor shall return usable equipment to the District as required.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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## **SECTION 01050 SURVEY WORK**

### **PART 1 - GENERAL**

#### **1.01 Datum**

- A. Vertical and horizontal datum are based on the coordinates and benchmarks shown on the Drawings. The Contractor shall establish other vertical and horizontal control from these Owner furnished reference points as required to properly lay out and construct the Work. All connections shall be installed based on actual elevations of existing structures to which connections are made.

#### **1.02 Lines and Grades**

- A. The Contractor shall lay out all work, including structures and pipelines, and shall be responsible for any errors resulting therefrom. In all questions arising as to proper location of lines and grades, the Owner's decision will be final.
- B. As part of the bid price for the construction of the improvements the Contractor shall provide and be responsible for the layout of all work specified in the contract.
1. All Contractor surveying shall be done by a registered land surveyor.
  2. Contractor shall submit the surveyor's credentials prior to any layout work.
  3. The Contractor shall provide all necessary surveys, field staking, and positioning for the construction of all components at the proper alignment, elevations, grades, and positions, as indicated on the Drawings and as required for proper operation and function. The Contractor shall stake the work limits.
- C. The Contractor's layout shall be based upon existing structures and the vertical and horizontal datum established by the Owner.
- D. The Contractor shall supply such labor as required, at no extra charge, to aid and assist the Owner's Representative in checking line, location and grades of the work as set by the Contractor, if requested by the Owner's Representative. Work shall include moving materials and equipment that interfere with a clear line of sight between horizontal control points and the construction work.
- E. The Contractor shall survey the forms of the first slab pour of all major structures to check line and grade of the concrete forms.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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## SECTION 01071 STANDARD REFERENCES

### PART 1 - GENERAL

#### 1.01 Abbreviations

A. Wherever used in these specifications, the following abbreviations will have the meanings listed:

<b><u>Abbreviation</u></b>	<b><u>Title</u></b>
AAMA	Architectural Aluminum Manufacturer's Association
AASHO	American Association of State Highway Officials
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturer's Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute, Inc.
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CALSPEC	Standard Specifications, State of California
CBC	California Building Code
CMC	California Mechanical Code
CPC	California Plumbing Code
CALTRANS	Department of Transportation State of California Business & Transportation Agency
FEDSPEC	Federal Specifications General Services Administration Specification and Consumer Information Distribution Branch
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Society of America
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association

<b><u>Abbreviation</u></b>	<b><u>Title</u></b>
OSHA	Occupation Safety and Health Act U.S. Department of Health Occupational and Health Administration
SSPWC	Standard Specifications for Public Works Construction
U.L., Inc.	Underwriter's Laboratories, Inc.

## **1.02 Applicable Publications**

- A. Wherever references are made to published specifications, codes, standards, or other requirements, and where no date is specified, it shall be understood that the latest specifications, standards, or requirements of the respective issuing agencies published as of the date that the work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the Drawings shall be waived because of any provision of, or omission from, said standards or requirements.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

## **SECTION 01201 PROJECT MEETINGS**

### **PART 1 - GENERAL**

#### **1.01 General**

#### **1.02 Preconstruction Conference**

- A. Date, Time and Location: A Preconstruction Conference will be held after execution of the Contract and before construction is started at the site. The Owner's Representative will fix the date, time and location of the meeting in accordance with requirements of the General Conditions.
- B. The Owner's Representative will prepare the agenda, preside at the meeting, and prepare and distribute a transcript of the proceedings to all parties.
- C. The Contractor shall provide data required, contribute appropriate items for discussion, and be prepared to discuss all items on the agenda.
- D. The Design Engineer shall respond to requests for information and provide construction administrative services as requested by the Owner and Construction Manager.
- E. Required Attendance
  - 1. Owner's Representative.
  - 2. Contractor and Major Subcontractors.
  - 3. Design Engineer.
  - 4. Owner.
  - 5. Representatives of government agencies having any degree of control or responsibility, if available.
- F. Agenda will include, but will not necessarily be limited to, the following:
  - 1. Designation of Responsible Personnel.
  - 2. Project Directory.
  - 3. Contractor's Emergency Contact List.
  - 4. Subcontractors.
  - 5. Coordination with other Contractors.
  - 6. Construction Schedule.
  - 7. Project Schedule Constraints.
  - 8. Outages and Tie-in Procedures.
  - 9. Processing of Shop Drawings and Distribution of Submittals.
  - 10. Contractor's List of Submittals.
  - 11. Processing of Field Decisions and Change Orders.
  - 12. Requirements for Copies of Contract Documents.
  - 13. Insurance in Force.
  - 14. Schedule of Values.
  - 15. Processing and Schedule of Payments.

16. Use of Premises.
17. Location of the Contractor's Temporary Facilities.
18. Contractor Responsibility for Safety and First Aid Procedures.
19. Security.
20. Housekeeping.
21. Record Drawings.
22. Letter of Notice to Proceed.
23. Any Other Project Related Items.

### **1.03 Progress Meetings**

- A. Regular progress meetings will be held at the site.
  1. Meetings will be held Monthly, or as required by the Owner.
  2. Agenda and minutes to be prepared by the Owner's Representative.
  3. Meetings to be held at field office or other mutually agreed location.
- B. Required Attendance
  1. Owner's Representative.
  2. Contractor and Major Subcontractors.
  3. Design Engineer.
  4. Owner.
- C. Agenda will include, but will not necessarily be limited to, the following:
  1. Work Progress
  2. Schedule
  3. Submittals
  4. RFIs
  5. Coordination with Owner
  6. Resolution of conflicts or problems
  7. Payment Requests
  8. Change Orders
  9. Safety
  10. Other items affecting progress of Work

### **1.04 Pre-Installation Meetings**

- A. Contractor will meet with manufacturers, suppliers and installers of major units of construction or equipment which require coordination between subcontractors and suppliers.
- B. Contractor to identify Pre-Installation Meetings at the regular Progress Meetings.
- C. Meeting topics include review conditions of installation; preparation, installation and/or application procedures; coordination with related work and others; and inspection requirements.
- D. Attendance

1. Contractor
2. Subcontractors and Installers
3. Suppliers
4. Manufacturers
5. Owner and/or Owners Representative
6. Engineer

#### **1.05 Facility Startup Meetings**

- A. As many meetings as required in advance of partial or complete facility startup.
- B. First meeting to be held prior to submitting Commissioning or Startup Plan.
- C. Agenda will include, but will not necessarily be limited to, the following:
  1. Preliminary discussion of startup plan.
  2. Coordination needed between various attendees.
  3. Potential problems associated with startup.
- D. Attendance
  1. Contractor
  2. Subcontractors
  3. Suppliers
  4. Manufacturers
  5. Owner and/or Owners Representative
  6. Engineer

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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## **SECTION 01300 SUBMITTALS**

### **PART 1 - GENERAL**

#### **1.01 Summary**

A. Section Includes:

1. Description of general requirements for Submittals for the Work.

#### **1.02 Submittals**

A. Where required by the Specifications, the Contractor shall submit descriptive information which will enable the Engineer to advise the Owner whether the Contractor's proposed materials, equipment or methods of work are in general conformance with the design concept and are in compliance with the drawings and specifications. The information to be submitted shall consist of drawings, specifications, descriptive data, certificates, samples, test results and other such information, all as specifically required in the Specifications.

B. The Contractor shall submit the following items:

1. Schedule of Submittals and Shop Drawings
2. List of Submittals, Shop Drawings, Product Data and Materials
3. Contractor's Safety Program
4. Designated Safety Supervisor
5. Designated "Competent Person(s)"
6. Schedule of Values
7. Construction Schedule
8. Substitutions List
9. Shop Drawings
10. Product Data
11. Samples
12. Material Safety Data Sheets
13. Operation and Maintenance Manuals
14. Project Closeout Information
15. Warranty Data
16. Others as Specified in the Technical Specifications
17. Manufacturer's Instructions
18. Manufacturer's Certifications and Test Reports

Quantity of Submittals:

19. Submit one (1) digital PDF format of all submittals.
  - a. PDF submittal shall be clear and readable.
  - b. PDF submittal shall be searchable (not scanned or copied).

- c. Annotate or mark submittal to clearly show the item or model being submitted.
- d. Submittal shall have a Cover Letter
  - 1) Cover Letter shall detail all relevant information included within the submittal package and describes the applicability of the submitted documentation.
  - 2) Cover Letter shall note all product substitutions and summarize all proposed products or materials not consistent with the project documents.
- e. Submittals shall have a detailed table of contents
- f. The Contractor shall utilize the relevant specification section to indicate conformance, substitutions, deviations or non-conformance to the technical information. Next to each specification paragraph or line item, utilize the following designations:
  - 1) Utilize a check mark "√" next to each specification to indicate full compliance to the specification paragraph or line item as a whole;
  - 2) If substitutions, deviations or non-conformance from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and noted by a number in the margin of the paragraph or line item that references to a detailed written explanation of the request for substitution, deviation, or non-conformance.
- g. Where applicable, a copy of the contract document plans that apply to the submitted equipment or materials shall be annotated to indicate specific changes or conformance to the Contract Documents.

20. If paper copies are submitted:

- a. Provide three (3) copies. Scanned hardcopy markups will be returned to the Contractor along with a standard submittal review sheet.
  - 1) Two (2) hard copies/samples shall go to the Engineer.
  - 2) One (1) hard copy/sample shall go to the Owner's Representative.

C. Where the Contractor is required by these Specifications to submit samples of products, the Contractor shall provide a sufficient number of physical samples to allow three (3) to be retained by the Owner's Representative of all structural and architectural products involving color, finish, texture, or the like.

D. List of Submittals:

- 1. Within thirty-five (35) days after the Notice to Proceed, the Contractor shall submit a List of Submittals to the Owner's Representative for review.
- 2. The List shall include all items of equipment and materials for mechanical, piping, architecture, electrical, heating and ventilating, equipment piping, and plumbing work; and the names of manufacturers with whom purchase orders have been or will be placed.
- 3. The List shall be arranged in the same order as the Specifications, and shall contain sufficient data to identify all items of material and equipment the Contractor proposes to furnish. The List shall include Specification and/or Drawing references.
- 4. After the submission is favorably reviewed and returned to the Contractor by the Owner's Representative, it shall become the basis for the submission of detailed manufacturer's drawings, catalog cuts, curves, diagrams, schematics, data, and information on each separate item for review as set forth in the Specifications. The approved list reviewed by the Owner's Representative and Engineer shall not constrain or restrict the number of submittals requested by the Engineer from the Contractor. The Contractor must submit all construction related materials to the Engineer for review and approval prior to installation or mobilization. If the

Contractor fails to submit on any individual item specific to any portion of the Construction project, the Engineer has every right to stop construction and require the Contractor to resubmit the proper documentation or re-perform the Activity based upon the Approved submittal documentation.

5. At the close of the project, all approved submittals shall be compiled in searchable PDF form and submitted to the Owner, separate from the required O&M manual submittal.
- E. The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall ensure that the material, equipment, or method of work shall be as described in the submittal.
1. Submittals shall contain all required information, including satisfactory identification of items, units, and assemblies in relation to the contract drawings and specifications.
  2. The Contractor shall verify that the material and equipment described in each submittal conforms to the requirements of the specifications and drawings.
  3. Unless otherwise approved by the Engineer, submittals shall be made only by the Contractor, who shall indicate by a signed stamp on the submittals that the Contractor has checked the submittals and that the work shown conforms to contract requirements and has been checked for dimensions and relationship with work of all other trades involved.
  4. If the information shows deviations from the specifications or drawings, the Contractor, by statement in writing accompanying the information, shall identify the deviations and state the reason(s) therefore.
  5. The Contractor shall ensure that there is no conflict with other submittals and shall notify the Engineer in each case where the Contractor's submittal may affect the work of another contractor or the Owner.
  6. The Contractor shall ensure coordination of submittals among the related crafts and subcontractors.

### **1.03 Submittal Transmittal Procedure**

- A. General: Submittals regarding material and equipment shall be accompanied by a transmittal form from the Contractor. A separate form shall be used for each specific item, class of material, equipment, and items specified in separate, discrete specification sections for which a submittal is required. However, submittals for various items shall be made with a single form only 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.
- B. Submittal Identification: Each set of submittals or samples shall be attached to the submittal transmittal form.
1. Submittal numbering shall be in accordance with Section 01312.
  2. All submittals shall show the contract title, shall indicate the name of the vendor, and shall indicate when the equipment and/or material will be required by the construction schedule.
  3. The submittal must be adequate to permit a comprehensive review without further reference to the Contractor. The documents submitted must be separately identifiable on the Contractor's submittal transmittal form.
- C. Deviation from Contract: If the Contractor proposes to provide material or equipment which does not conform to the specifications and drawings, this shall be indicated under "deviations" on the submittal transmittal form accompanying the submittal copies.

1. 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.
  2. If any deviations from the Contract requirements are not noted on the submittal, the review of the shop drawing shall not constitute acceptance of such deviations.
- D. Submittal Completeness: Submittals which do not have all the information required to be submitted, including deviations, shall be considered as not complying with the intent of the contract and are not acceptable and will be returned without review.
1. 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.
- E. Review of Subsequent Resubmittals: It is considered reasonable that the Contractor shall make a complete and acceptable submittal to the Owner's Representative at least by the second submission of data. At the discretion of the Engineer costs associated with the review of any subsequent resubmittals may be borne by the Contractor. The Contractor will be billed for these costs by the Owner. Costs due may be deducted from progress payments due the Contractor by the Owner.

#### 1.04 Submittal Review

- A. Within 21 calendar days after receipt of the submittal by the Engineer, the submittal will be reviewed by the Engineer and the Engineer will return the marked-up submittal. On complex drawings and equipment, the Engineer shall acknowledge receipt within seven (7) days and advise the Contractor when the submittal will be returned. The returned submittal shall indicate one of the following actions.
1. If the review indicates that the material, equipment, or work method is in general conformance with the design concept and complies with the drawings and specifications, submittal copies will be marked "**NO EXCEPTIONS TAKEN**". In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.
  2. If the review indicates limited corrections are required, copies will be marked "**MAKE CORRECTIONS NOTED**". The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in operation and maintenance data, a corrected copy shall be provided. Otherwise, no resubmittal will be required.
  3. If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "**AMEND AND RESUBMIT**". The Contractor shall not undertake work covered by this submittal until the submittal has been revised, re-submitted, and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".
  4. If the review indicates that the material, equipment, or work method is not in general conformance with the design concept or in compliance with the drawings and specifications, copies of the submittal will be marked "**REJECTED - SEE REMARKS**". Submittal with deviations which have not been identified clearly may be rejected. The Contractor shall not undertake work covered by such submittal until a new submittal is made and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".
  5. If the review has identified comments that pertain to a separate item or has general comments not subject to the project conformance, various comments within the Submittal review process can be marked "**OTHER**," requiring either no further action or action specific to a separate topic.

- B. Review of drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide shall not relieve the Contractor of responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Engineer, the Owner's Representative or the Owner, or by any officer, employee or subcontractor thereof, and the Contractor shall have no claim under the contract on account of the failure or partial failure of the method of work, material, or equipment so reviewed.
1. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" shall mean that the Owner has no objection to the Contractor, upon its own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.
  2. Favorable review of submittals does not constitute a change order to the Contract requirements.
  3. 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.
  4. 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.
  5. 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.
  6. The favorable review of shop drawings shall be obtained prior to the fabrication, delivery and construction of items requiring shop drawing submittal.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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## **SECTION 01301 SCHEDULE OF VALUES**

### **PART 1 - GENERAL**

#### **1.01 Summary**

- A. This Section defines the process whereby the Schedule of Values (lump sum price breakdown) shall be developed. Monthly progress payment amounts shall be determined from the monthly progress updates of the Schedule activities.

#### **1.02 Submittals**

A. Preliminary Schedule of Values

1. The Contractor shall submit a preliminary Schedule of Values for the major components of the work at the Preconstruction Conference. The listing shall include, at a minimum, the proposed value for major work components in accordance with the Contract Documents and Bid Schedule.
2. The Contractor and Owner's Representative shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the Owner's Representative, these are necessary to establish fair and reasonable allocation of values for the major work components.
  - a. Front end loading will not be permitted.
  - b. The Owner's Representative may require reallocation of major work components from items in the above listing if, in the opinion of the Owner's Representative, such reallocation is necessary.
  - c. This review and any necessary revisions shall be completed within 15 days from the date of Notice to Proceed.

B. Detailed Schedule of Values

1. The Contractor shall prepare and submit a detailed Schedule of Values to the Owner's Representative within 30 days from the date of Notice to Proceed.
2. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major work components. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts, sufficient detailed breakdown shall be provided to meet this requirement.
3. The Owner's Representative shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the Owner's Representative, a greater number of Schedule of Values items than proposed by the Contractor are necessary, the Contractor shall add the additional items so identified by the Owner's Representative.
4. The Contractor and Owner's Representative shall meet and jointly review the detailed Schedule of Values within 35 days from the date of Notice to Proceed.
5. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the Contractor and a revised detailed Schedule of Values shall be submitted within 40 days from the date of Notice to Proceed.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

## **SECTION 01311 SCHEDULING AND REPORTING**

### **PART 1 - GENERAL**

#### **1.01 General**

- A. The scheduling of the work under the Contract shall be performed in accordance with the requirements of this Section.
- B. The development of the schedule, the cost loading of the schedule, monthly payment requisitions and project status reporting requirements of the Contract shall employ computerized Critical Path Method (CPM) or bar chart scheduling.

#### **1.02 Definitions and Requirements**

- A. Critical Path Method (CPM): CPM, as required by this Section, shall be interpreted to be generally as outlined in the Association of General Contractors (AGC) publication, "The Use of CPM in Construction." except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this specification and the AGC Document, this specification shall govern.
- B. Construction Schedules: Construction schedules shall include a graphic network diagram and computerized construction schedule reports.
- C. Networks: The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets.
  - 1. Individual sheets shall not exceed 36-inch by 60-inch.
- D. All construction activities and procurement shall be indicated in a time-scaled format and a calendar time line shall be shown along the entire sheet length.
  - 1. Each activity arrow or node shall be plotted so that the beginning and completion dates of each activity are accurately represented along the calendar time line.
  - 2. All activities shall be shown using the symbols that clearly distinguish between critical path activities, non-critical activities and free float for each non-critical activity.
  - 3. All activity items shall be identified by their respective Activity Number, Responsibility Code, Work Duration, and their Dollar Value.
  - 4. All non-critical path activities shall show their total float time in scale form by utilizing a dotted line or some other graphical means.
- E. Duration Estimates: The duration estimate indicated for each activity shall be computed in calendar days and shall represent the single best estimate considering the scope of the activity work and resources planned for the activity. Except for certain non-labor activities, such as curing of concrete or delivery of materials, activity duration shall not exceed 10 calendar days nor be less than one calendar day unless otherwise accepted by the Owner's Representative.
- F. Float Time: Float time shall be as follows:
  - 1. Definition: Unless otherwise provided herein, float as referenced in these documents, is total float. Total float is the period of time measured by the number of calendar days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, that activity then becomes

part of the critical path and controls the end date of the project. Thus, the delay of the non-critical path activity beyond its float period will cause delay to the project itself.

2. Float Ownership: Neither the Owner nor the Contractor owns the float time. The project owns the float time. As such, liability for delay of the project completion date rests with the party actually causing delay to the project completion date. For example, if Party A uses some, but not all of the float time and Party B later uses the remainder of the float time as well as additional time beyond the float time, Party B shall be liable for the costs associated with the time that represents a delay to the project's completion date. Party A would not be responsible for any costs since it did not consume all of the float time and additional float time remained, therefore, the project's completion date was unaffected.

### **1.03 Submittals**

- A. Submit schedules per requirements of Section 01300 - Submittals.
- B. Preliminary Schedule
  1. The Contractor shall submit a preliminary schedule document at the Preconstruction Conference, to identify the manner in which the Contractor intends to complete all work within the Contract Time.
- C. Original Schedule
  1. The Contractor shall submit an original schedule document within 21 days following the Preconstruction Conference.
- D. Revised or Updated Schedules
  1. Submit when required to reflect changes to original schedule.

### **1.04 Construction Schedule**

- A. The schedule shall indicate the major components of the project work and the sequence relations between major components and subdivisions of major components.
- B. The schedule shall be cost loaded based on the schedule of values as approved by the Owner's Representative.
- C. Sufficient detail shall be included for the identification of subdivisions of major components into such activities as:
  1. All work tasks requiring a partial or complete shutdown of existing facilities.
  2. Foundation subgrade preparation.
  3. Foundation concrete.
  4. Structural concrete.
  5. Yard piping.
  6. Equipment installation.
  7. Electrical.
  8. Instrumentation and control work.
  9. Site work.
  10. Other important work within the overall project scope.
- D. Planned durations and start dates shall be indicated for each work item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to

exceed 36-inch by 60-inch in size. Not more than one sheet shall be employed to represent this information.

### **1.05 Schedule Review**

- A. The Owner's Representative and the Contractor shall meet to review and discuss the preliminary schedule within 14 days after it has been submitted to the Owner's Representative.
  - 1. The Owner's Representative's review and comment on the schedules shall be limited to Contract conformance with the sequencing and milestone requirements as stated in other sections of the specifications.
  - 2. The Contractor shall make corrections to the schedules necessary to comply with the Contract requirements and shall adjust the schedules to incorporate any missing information requested by the Owner's Representative.

### **1.06 Acceptance**

- A. The acceptance of the Contractor's schedule by the Owner's Representative and Owner will be based solely upon the schedule's compliance with the Contract requirements.
- B. By way of the Contractor assigning activity durations and proposing the sequence of the Work, the Contractor agrees to utilize sufficient and necessary management and other resources to perform the work in accordance with the schedule.
- C. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.
- D. Submission of the Contractor's progress schedule to the Owner or Owner's Representative shall not relieve the Contractor of the Contractor's total responsibility for scheduling, sequencing, and pursuing the Work to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed work.

### **1.07 Monthly Updates and Periodic Schedule Submittals**

- A. Following the acceptance of the Contractor's Original Construction Schedule, the Contractor shall monitor the progress of the Work and adjust the schedule each month to reflect actual progress and any changes in planned future activities.
  - 1. Each schedule update submitted must be complete including all information requested in the original schedule submittal.
  - 2. Each update shall continue to show all work activities including those already completed.
  - 3. These completed activities shall accurately reflect the "as built" information by indicating when the work was actually started and completed.
- B. Neither the submission nor the updating of the Contractor's original schedule submittal nor the submission, updating, change or revision of any other report, curve, schedule or narrative submitted to the Owner's Representative by the Contractor under this Contract, nor the Owner's Representative's review or acceptance of any such report, curve, schedule or narrative shall have the effect of amending or modifying, in any way, the Contract completion date or milestone dates or of modifying or limiting, in any way, the Contractor's obligations under this Contract. Only a signed, fully executed change order can modify these contractual obligations.
- C. The monthly schedule update submittal will be reviewed with the Contractor during a construction progress meeting held on a month end date to be determined. The goal of these meetings is to enable the Contractor and the Owner's Representative to initiate appropriate remedial action to minimize any known or foreseen delay in completion of the Work and to determine the amount of Work completed since the last month's schedule update.

1. The status of the Work will be determined by the percent complete of each activity shown in the Network Diagram.
  2. These meetings are considered a critical component of the overall monthly schedule update submittal and the Contractor shall have appropriate personnel attend.
  3. As a minimum, these meetings shall be attended by the Contractor's Project Manager and General Superintendent.
  4. Within seven (7) calendar days after the progress meeting, the Contractor shall submit the revised schedule.
  5. Within five (5) calendar days of receipt of the above noted revised submittals, the Owner's Representative will either accept or reject the monthly schedule update submittal.
  6. If accepted, the percent complete shown in the monthly update will be the basis for the Application for Payment to be submitted by the Contractor.
  7. If rejected, the update shall be corrected and resubmitted by the Contractor before the Application for Payment for the update period can be processed.
- D. Schedule Revisions: The Contractor shall highlight or otherwise identify all changes from the previous schedule. The Contractor shall modify any portions of the schedule which become infeasible because of activities behind schedule or for any other valid reason.

#### **1.08 Change Orders**

- A. Upon approval of a change order, or upon receipt by the Contractor of authorization to proceed with additional work, the change shall be reflected in the next submittal of the schedule by the Contractor.
- B. The Contractor shall utilize a sub-network in the schedule depicting the changed work and its effect on other activities.
- C. This sub-network shall be tied to the main network with the appropriate logic so that a true analysis of the Critical Path can be made.

#### **1.09 Project Status Reporting**

- A. In addition to the submittal requirements for the scheduling identified in this Section, the Contractor shall provide monthly project status reports.
- B. The Contractor shall prepare monthly written narrative reports of the status of the project for submission to the Owner's Representative. Written status reports shall include:
  1. The status of major project components (Percent Complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.
  2. The progress made on critical activities indicated on the schedule.
  3. Explanations for any lack of work on critical path activities planned to be performed during the last month.
  4. Explanations for any schedule changes, including changes to the logic or to activity durations.
  5. A list of the critical activities scheduled to be performed in the next two month period.
  6. The status of major material and equipment procurement.
  7. The value of materials and equipment properly stored at the site, but not yet incorporated into the work-in-place.
  8. Any delays encountered during the reporting period.

9. An assessment of inclement weather delays and impacts to the progress of the Work.
- C. The Contractor may include any other information pertinent to the status of the project. The Contractor shall include additional status information requested by the Owner's Representative.

**1.10 Inclement Weather Provisions of the Schedule**

- A. The Contractor's construction schedule shall include lost days on the CPM schedule's critical path due to inclement weather typical for the area of construction based on the average rain days for the past five (5) years.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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**SECTION 01312**  
**WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT**

**PART 1 WEB DATABASE**

**1.01 SUMMARY**

- A. The project team will use and maintain a web-based database as the primary means of communication related to the Project's correspondence, submittals, requests for information (RFIs), advisory notices, and non-compliance issues. Correspondence from the Contractor shall be sent to the Construction Manager via the District's web-based database Program.
- B. The Construction Manager and Contractor shall utilize the District's web-based database system for electronic submittal of all data and documents (unless specified otherwise by the Construction Manager) throughout the duration of the Contract. The web-based database will be a web-based electronic media site that is hosted by the District. The web-based database will be made available to all Contractor's project personnel. The joint use of this system is to facilitate; electronic exchange of information, automation of key processes, and overall management of the Contract. The web-based database shall be the primary means of project information submission and management. When required by the Construction Manager, paper documents will also be required. In the event of discrepancy between the electronic version and paper documents, the paper documents will govern.

**1.02 USER ACCESS LIMITATIONS**

- A. The Construction Manager will control the Contractor's access to the web-based database by allowing access and assigning user profiles to accepted Contractor personnel. User profiles will define levels of access into the system; determine assigned function-based authorizations (determines what can be seen) and user privileges (determines what they can do).

**1.03 AUTOMATED SYSTEM NOTIFICATION AND AUDIT LOG TRACKING**

- A. Review comments made (or lack thereof) by the Construction Manager and Engineer on Contractor submitted documentation shall not relieve the Contractor from compliance with requirements of the Contract Documents. The Contractor is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents. The Construction Manager's acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the Contractor's submitted information.

**1.04 CONTRACTOR RESPONSIBILITY**

- A. The Contractor shall be responsible for the validity of their information placed in the web-based database and for the abilities of their personnel. Accepted users shall be knowledgeable in the use of computers, including Internet Browsers, email programs, CAD drawing applications, and Adobe Portable Document Format (PDF) document distribution program. Adobe PDF documents will be created through electronic conversion rather than optically scanned whenever possible.

**1.05 USER ACCESS ADMINISTRATION**

- A. Provide a list of Contractor's key web-based database personnel for the Construction Manager's acceptance. The Construction Manager is responsible for adding and removing users from the system. The Construction Manager reserves the right to perform a security check on all potential users.

**1.06 TRAINING**

- A. The Construction Manager has arranged for the following training to be provided to the Contractor. The Construction Manager will provide a one-hour training class to the Contractor within ten (10) days of NTP at a time mutually agreeable to Contractor and Construction Manager. Thereafter the Construction Manager will provide up to one hour of additional training via telephone during the project per month of the project life.

## **PART 2 EQUIPMENT**

### **2.01 SUMMARY**

- A. In order to process correspondence, submittals, and RFIs, the Contractor must provide and have in place for its own use the required basic components outlined below.

### **2.02 HARDWARE**

- A. A computer with internet access and sufficient capabilities to perform all project duties; a scanner at least large enough to scan 11" x 17" sheets with sufficient resolution to maintain clarity and legibility of the document at its native size; and a color printer of sufficient size and capacity to accept incoming correspondence as described in this section.

### **2.03 SOFTWARE**

- A. Adobe Acrobat 9 or higher; Microsoft's Internet Explorer v7 or higher; Microsoft Office 2003 or higher, including but not limited to Microsoft Word and Microsoft Excel.

### **2.04 FACILITIES**

- A. The Contractor shall make its own arrangements to provide high-speed (minimum speed: download 256Mbps / upload 10Mbps) internet connection for its own use as soon as practicable.

## **PART 3 EXECUTION**

### **3.01 SUMMARY**

- A. Items to be uploaded to the web-based database by the Construction Manager include but are not limited to: RFI responses, Submittal comments, Clarification letters, Design Clarifications, Field Orders, et al. These items will be emailed as attachments in PDF file format. These attachments may include files that need to be viewed and/or printed in color. Formal letters, stop notices, Field Orders, Progress Payment Requests, and Contract Change Orders will always include a wet-signed hard copy.

### **3.02 PROCORE UTILIZATION**

- A. All project related correspondence (RFIs, submittals, etc.) originated by the Contractor or Subcontractor, Supplier, et al. shall be directed to the Construction Manager, unless otherwise indicated in the Specifications.

### **3.03 SUBMITTALS**

- A. The use of the electronic communication does not waive the requirement for the provision of hard copies of all formal correspondence and submittals. The hard copies of all documents must match the electronic copies of all correspondence and submittals.
- B. Submittals shall be in accordance with Section 01 33 00, Submittal Procedures. The provisions of Section 01 33 00 shall apply both to electronic copies and hard copies of submittals.
- C. In addition to above, the web-based database shall be utilized in connection with submittal preparation and information management required by but not limited to Sections:
  1. Section 01 32 16 – Construction Progress Schedules and Reports.
  2. Section 01 33 00 – Submittal Procedures.
  3. Section 01 78 23 – Operation and Maintenance Data
- D. The web-based database will be utilized by all other Sections not listed above and as required by the Construction Manager.

### **3.04 TERMINATION IN USE**

- A. The District may request a termination of the use of the web-based database for the electronic submission of data, and alternatively the use of paper documents submitted in accordance with the Contract Documents by providing notification in writing with ten (10) days notice that it intends to discontinue use of the web-based database.

### **3.05 LABELING FORMAT**

- A. The subject line of each email, and the file name of any attached files shall begin with the file labeling scheme:
  - 1. RFI\_XXX.Y\_(Contractor Name)\_(Subject).
  - 2. Letter\_XXX\_(Contractor Name)\_(Subject).
  - 3. Transmittal\_XXX\_(Contractor Name)\_(Subject).
  - 4. PCO\_XXX.Y\_(Contractor Name)\_(Subject).
  - 5. Submittal\_XX XX XX-YY-Z\_(Contractor Name)\_(Subject).
- B. The first section of the label indicates the type of correspondence (i.e RFI). "XXX" indicates a unique number, sequentially assigned for the given piece of correspondence. "Y" is a sequential letter assigned for revised or resubmitted documents, i.e. A, B, or C being the 1st, 2nd, and 3rd revision or resubmittal, respectively. "(Contractor Name)" indicates to the database that the correspondence is from the Contractor. The Contractor will indicate the subject at the end of the numbering scheme. For submittals, XX XX XX denotes the Specification Number, YY denotes the sequential number of submittals in that Specification Section, and "ZZ" indicates whether the submittal is an original or a resubmittal, as described in Section 01 33 00, Submittal Procedures. Each piece of correspondence shall be sent in a separate email. O&M submittal numbering shall be as specified in Section 01 78 23, Operation and Maintenance Data

### **3.06 SUBMITTALS**

- A. If a submittal package has multiple items that are not directly related, each item shall be considered a separate submittal and shall be sent separately. For example, "Concrete Mix Design," and "Concrete Curing Compound" shall be submitted as separate items to the Construction Manager.

### **3.07 ORIGINAL DOCUMENTS**

- A. Where possible, the Contractor will obtain the electronic document from its original source to maintain the integrity, legibility, and searchability of the document.

### **3.08 ORGANIZATION**

- A. The information included in the attachments shall be organized in a logical and thoughtful manner. Where the information originated in a tabbed format (a binder, for example), the scanned and/or converted PDF file shall be electronically bookmarked accordingly using the "bookmark" function of Adobe Acrobat 9 Std.

### **3.09 PRINTING**

- A. Except where otherwise indicated, the Contractor will receive no hard copies of the above outlined correspondence. The Contractor will be required to print for its use, in color if necessary, any record copies, field copies, subcontractor copies, etc., if such copies are desired.

### **3.10 PROJECT FORMS**

- A. The Contractor may use its own correspondence forms to be attached to correspondence emails as long as the Contractor's forms comply with this and all submittal sections.

**END OF SECTION**

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## SECTION 01360 OPERATING AND MAINTENANCE INFORMATION

### PART 1 - GENERAL

#### 1.01 Summary

- A. Contractor shall supply Operations and Maintenance (O&M) Manuals for equipment as specified in other parts of the Project Documents for future use by the Owner or governing agency.

#### 1.02 Description

- A. The Contractor shall provide four (4) sets of operating and maintenance instructions for all equipment and devices furnished under this contract and one (1) pdf set. The operating and maintenance material supplied shall be original printed copies of manufacturer's brochures and/or manuals. Photocopied material will not be acceptable. Operating and maintenance instructions for each item of equipment and each equipment assembly shall consist of:
1. Names and addresses of manufacturer, nearest representative of manufacturer, and nearest supplier of manufacturer's equipment and parts
  2. For equipment requiring lubrication, the manufacturer's recommended lubricants and lubrication schedule.
  3. For equipment containing integral electrical controls, diagrams showing internal and connection wiring.
  4. Specified operating and maintenance information. This information shall include, but not necessarily be limited to, the following items:
    - a. Equipment data: The Contractor shall provide a good quality photocopy of the Equipment Maintenance Summary sheets for review and shall make corrections to the originals as noted in the submittal review comments. Sufficient copies of the blank forms will be furnished by the Owner.
    - b. Start-up procedures: These instructions shall include equipment manufacturer's recommendations regarding installation, adjustment, calibration and troubleshooting.
    - c. Operating procedures: These instructions shall include the equipment manufacturer's recommended step-by-step procedures for starting, operating, and stopping the equipment under all modes of operation.
    - d. Preventive maintenance procedures: These instructions shall include the equipment manufacturer's recommendations regarding the steps and schedules to be followed in maintaining the equipment.
    - e. Parts list: This list shall include generic title and identification number of each component part of the equipment.
    - f. Exploded views: These shall be provided where appropriate.
    - g. Spare parts list: This list shall include the manufacturer's recommendations of number of parts that should be stored by the Owner.
    - h. Overhaul instructions: These instructions shall consist of the manufacturer's directions for the disassembly, repair and reassembly of the equipment.

### 1.03 Submittal Procedure

- A. Operating and maintenance (O&M) instructions shall be submitted to the Owner's Representative accompanied by the submittal transmittal form described in Section 01300 - Submittals.
- B. Required submittals:
  - 1. Initial Submittal: One (1) copy of O & M Manual shall be submitted for approval. Initial O&M submittal may be hard copy or PDF format.
  - 2. Intermediate Submittal: One (1) copy of revised O & M Manual shall be submitted for approval. Intermediate O&M may be hard copy or PDF format.
  - 3. Final Submittal: Once O&M Manual is completely approved, submit four (4) paper copies and one (1) PDF.
    - a. O&M Manual drawings shall represent the As-Built system and include all Approved modifications to the original design.
    - b. Final submittal shall also include AutoCAD drawing files for all electrical distribution and control drawings.
  - 4. The submitted O&M Manuals shall have a separate submittal numbering system from the general equipment and material submittals required to confirm conformance with the design specifications.
- C. PDF Format shall be manufacturer's data converted directly to PDF. Scanned PDF information is not acceptable unless approved by the Owner's Representative.
  - 1. PDF documents shall be bookmarked, indexed and in searchable format.
- D. For ease of identification, each manufacturer's brochure and manual shall be appropriately labeled with the equipment name, equipment number and specification number, as it appears in the contract documents.
- E. The information shall be organized in binders in numerical order by the specification section numbers assigned in the contract documents. The binders shall be provided with a table of contents and tab sheets to permit easy location of desired information. Each numerical section shall contain a complete itemized data list with equipment name and equipment number for the information contained in that section. Binders shall be three-ring with clear vinyl pockets on the front and spine. The binder title shall be clearly visible on the spine and the front cover.
- F. The following procedures shall be used:
  - 1. Contractor shall include in each O&M submittal a good quality photocopy of associated Equipment Maintenance Summary sheets, for each specification section for review.
  - 2. Submittals will be returned with a review sheet and comments.
  - 3. Contractor shall resubmit, if requested by the Owner's Representative, and retain all copies of approved submittals until all sections have been approved.
  - 4. When all sections have been approved, Contractor shall organize and bind the manuals for all the sections of the contract specifications according to the above instructions and submit one complete set of O&M Manuals for final review. Contractor shall submit separately and unbound the completed original Equipment Maintenance Summary sheets.
  - 5. Final review will be for the organization and binding of a complete set of manuals as specified and will not include review of previously approved material.
  - 6. When the complete set is approved, the Contractor shall submit four (4) complete sets to the Owner's Representative as approved and specified.

G. If the manufacturer's standard brochures and manuals are used to describe operating and maintenance procedures, such brochures and manuals shall be modified to reflect only the model or series of equipment used on this project.

1. Clearly mark or annotate the actual model supplied for the project.
2. Extraneous material shall be crossed out neatly or otherwise annotated or eliminated.

#### **1.04 Field Changes**

A. Following the acceptable installation and operation of an equipment item, the item's operating and maintenance instructions, including drawings, shall be modified and supplemented by the Contractor to reflect any as-built conditions, field changes or information required by field conditions.

#### **1.05 Payment**

A. Acceptable operating and maintenance information must be delivered to the Owner's Representative before the Contractor can be paid for more than 80 percent of the purchase value of that equipment and prior to installation of the equipment. Purchase value shall be the net price for the equipment as given on the paid invoice. Acceptable operating and maintenance information for the project must be delivered to the Owner's Representative prior to the project being 75 percent complete. Progress payments for work in excess of 75 percent completion will not be made until the specific acceptable operating and maintenance information has been delivered to the Owner's Representative.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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**SECTION 01500**  
**CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS**

**PART 1 - GENERAL**

**1.01 Summary**

- A. The Contractor shall provide all temporary facilities and utilities required for prosecution of the work, protection of employees and the public, protection of the work from damage by fire, weather or vandalism, and such other facilities as may be specified or required by any legally applicable law, ordinance, rule, or regulation.
- B. The Contractor shall keep the work site clean and free from rubbish and debris. Materials and equipment shall be removed from the site when they are no longer necessary on a daily basis as directed by the Owner's Representative. All cables, slings and other materials used to set the pipe and equipment shall be removed from the project site. Upon completion of the work and before final acceptance, the work site shall be cleared of equipment, unused materials, and rubbish to present a clean and neat appearance.

**1.02 Temporary Facilities**

A. Electrical Service

- 1. The Contractor shall arrange, at its own cost, with the local utility to provide adequate temporary electrical service at a mutually agreeable location.
- 2. The Contractor shall then provide adequate jobsite distribution facilities conforming to applicable codes and safety regulations.
- 3. The Contractor shall provide, at its own cost, all electric power required for construction, testing, general and security lighting, and all other purposes whether supplied through temporary or permanent facilities.

B. Water

- 1. The Contractor will be provided access to water on the project site at no charge. Contractor shall rent and install a fire hydrant meter for the duration of the Project and all construction water shall be metered.
- 2. Water used for human consumption shall be kept free from contamination and shall conform to the requirements of the State and local authorities for potable water.

C. Heating and Ventilation

- 1. The Contractor shall provide means for heating and ventilating all work areas as may be required to protect the Work from damage by freezing, high temperatures, weather, or to provide a safe environment for workers.
- 2. Unvented direct fired heaters shall not be used in areas where freshly placed concrete will be exposed to the combustion gases until at least two hours after the concrete has attained its initial set.

D. Sanitary Conveniences

- 1. The Contractor shall provide suitable and adequate sanitary conveniences for the use of all persons at the site of the Work.

2. Such conveniences shall include chemical toilets or water closets and shall be located at appropriate locations at the site of the Work.
3. All sanitary conveniences shall conform to the regulations of the public authority having jurisdiction over such matters.
4. At the completion of the Work, all such sanitary conveniences shall be removed and the site left in a sanitary condition.

E. Telephone

1. The Contractor shall arrange, at its own cost, with the local utility to provide adequate temporary telephone service for its use during construction.
2. Contractor shall pay for all telephone services required for its own use.
3. The Contractor and its subcontractors shall furnish reliable telephone, cellular and/or wireless internet service capable of conducting and participating in remote, regularly scheduled progress meetings via Microsoft Teams, Zoom, or equal.

**1.03 Construction Facilities**

A. Construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities shall be of ample size and capacity to adequately support and move the loads to which they will be subjected. Railings, enclosures, safety devices, and controls required by law or for adequate protection of life and property shall be provided.

B. Staging and Falsework

1. Temporary supports shall be designed by a professional registered engineer with an adequate safety factor to assure adequate load bearing capability. If requested by the Owner's Representative, the Contractor shall submit design calculations for staging and shoring prior to application of loads.
2. Excavation support shall be in accordance with applicable codes and regulations.

C. Temporary Enclosures

1. When sandblasting, spray painting, spraying of insulation, or other activities inconveniencing or dangerous to property or the health of employees or the public are in progress, the area of activity shall be enclosed adequately to contain the dust, over-spray, or other hazard.
2. In the event there are no permanent enclosures of the area, or such enclosures are incomplete or inadequate, the Contractor shall provide suitable temporary enclosures.

D. Warning Devices and Barricades

1. The Contractor shall adequately identify and guard all hazardous areas and conditions by visual warning devices and, where necessary, physical barriers.
2. Such devices shall, as a minimum, conform to the requirements of Cal/OSHA.

**1.04 Protection and Restoration of Existing Improvements**

A. The Contractor shall be responsible for the protection of public and private property at and adjacent to the Work and shall exercise due caution to avoid damage to such property.

- B. The Contractor shall repair or replace all existing improvements which are not designated for removal (e.g., curbs, sidewalks, survey points, fences, walls, signs, utility installations, pavements, structures, etc.) and are damaged or removed as a result of its operations. Repairs and replacements shall be at least equal to existing improvements and shall match them in finish and dimension.
- C. Trees, lawns, and shrubbery that are not to be removed shall be protected from damage or injury. If damaged or removed because of the Contractor's operations, they shall be restored or replaced in as nearly the original conditions and location as is reasonably possible. Lawns shall be re-seeded and covered with suitable mulch.
- D. The Contractor shall give reasonable notice to occupants or owners of adjacent property to permit them to salvage or relocate plants, trees, fences, sprinklers, and other improvements within the right-of-way which are designated for removal or would be destroyed because of the Work.

### **1.05 Access Roads**

- A. Access roads shall be maintained to all storage areas and other areas to which frequent access is required. Similar roads shall be maintained to all existing facilities on the site of the Work to provide access for delivery of material and for maintenance and operation. Where such temporary roads cross buried utilities that might be injured by the loads likely to be imposed, such utilities shall be adequately protected by steel plates or wood planking, or bridges shall be provided so that no loads shall discharge on such buried utilities.

### **1.06 Air Pollution and Dust Control**

- A. The Contractor's and subcontractor's heavy equipment shall comply with the California Air Resources Board (CARB) regulations for off-road diesel and large spark-ignition engine vehicles and equipment. Owner may require removal and replacement of heavy equipment not conforming to CARB regulations.
- B. The Contractor at its expense shall take whatever steps, procedures, or means as are required to prevent abnormal dust conditions being caused by its operations in connection with the execution of the Work; and on any unpaved road which the Contractor or any of its subcontractors are using, excavation or fill areas, demolition operations, or other activities.
  - 1. Control shall be by sprinkling, use of dust palliatives, modification of operations, or any other means acceptable to agencies having jurisdiction.
  - 2. Haul routes shall be kept visibly wet during excavation and hauling operations.
  - 3. Exposed stockpiles of soil and other backfill material shall be enclosed, have silt fencing, be covered, be watered regularly or have soil binders added to minimize erosion.
  - 4. Dust-producing activities shall be suspended when high winds create construction-induced visible dust plumes moving beyond the project site, in spite of dust control measures.
- C. Unless the construction dictates otherwise, and unless otherwise approved by the Owner's Representative, the Contractor shall furnish and operate a self-loading motor sweeper with spray nozzle at least once each working day to keep paved areas acceptably clean whenever construction, including restoration, is incomplete.

1. If visible soil material is carried onto adjacent public streets, such streets shall be swept with water sweepers.

### **1.07 Noise Abatement**

- A. Operations at the Worksite shall be performed so as to minimize unnecessary noise.
- B. Special measures shall be taken to suppress noise during night hours.
- C. Noise levels due to construction activity shall not exceed the levels specified by local ordinance.
- D. Internal combustion engines used on the Work shall be equipped with a muffler of a type recommended by the manufacturer. No internal combustion engine shall be operated without said muffler.
- E. The Contractor shall abide by Section 9.02.060(d) of the Calaveras County Code (Noise Ordinance) that states construction activities generating noise are exempt from the County's noise level standards provided that all construction in or adjacent to residential areas be limited to the daytime hours between 7:00 a.m. to 6:00 p.m.

### **1.08 Working Hours**

- A. Construction shall be allowed only between the hours of seven (7:00) a.m. and five (5:00) p.m. on weekdays unless otherwise approved in writing by the Owner's Representative.
- B. The 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 outside 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. Any work specifically required to be performed outside the normal working hours is excluded from the provisions of this paragraph.
- C. The Contractor shall notify the Owner's Representative at least one working day prior to any work outside the normal working hours defined above, on weekends or holidays.

### **1.09 Drainage Control**

- A. In all construction operations, care shall be taken not to disturb the existing drainage pattern whenever possible.
- B. Particular care shall be taken not to direct drainage water onto private property. Drainage water shall not be diverted to streets or drainage ways inadequate for the increased flow.
- C. Drainage means shall be provided to protect the Work and adjacent facilities from damage due to water from the site or due to altered drainage patterns from construction operations.
- D. Temporary provisions shall be made by the Contractor to insure the proper functioning of gutters, storm drain inlets, drainage ditches, culverts, irrigation ditches, and natural water courses.

### **1.10 Stormwater Pollution Prevention**

- A. The work area on the project site is less than 1 acre; therefore, coverage under the NPDES General Permit for Stormwater Discharges Associated with Construction Activity (General Permit), Order No. 2009-DWQ (As amended by 2010-0014-DWQ and 2012-0006-DWQ)

and NPDES No. CAS000002, Effective July 1, 2010 is not required. The Contractor is responsible for limiting site disturbance below 1 acre.

- B. The Contractor shall provide a Water Pollution Control Plan (WPCP). The WPCP shall be prepared, and field implemented by an experienced and Qualified SWPPP Developer (QSD) and Practitioner (QSP) individual licensed in the State of California. The WPCP shall conform to the California Stormwater Quality Association (CASQA) Construction BMP Handbook. The Contractor shall submit this plan within ten (10) calendar days of Notice to Proceed. Construction work shall not commence until the Water Pollution Control Plan is approved, proper approvals and permits have been secured, and best management practices (BMPs) have been installed to protect the storm drainage system.
- C. The Contractor shall amend the Water Pollution Control Plan whenever there is a change in BMPs and/or operations which may affect the discharge of pollutants to the storm drainage system or when deemed necessary by the Owner's Representative when the Plan is not effectively achieving the water pollution control objectives. Amendments shall describe additional BMPs or revised operations and shall be submitted to the Owner's Representative for review and approval prior to implementation of revised practices.
- D. At a minimum, the Plan shall provide or describe:
  - 1. Name, title, phone number(s) and e-mail address of person responsible for ensuring compliance for the project. This individual shall ensure that appropriate BMPs are installed, inspected and maintained throughout the project, and removed and properly disposed of at the end of the job. BMPs shall be inspected daily and repaired/replaced as needed. This person shall also monitor the weather and make arrangements for stormwater quality protection in the event of a predicted storm. This person shall coordinate with the Owner's Representative on all stormwater issues and shall notify the Owner's Representative immediately of any incidents that discharge pollutants to the storm drain system and/or receiving waters.
  - 2. Drawing or map showing:
    - a. Limits of construction and locations of staging, storage and ingress/egress areas
    - b. Drainage patterns in the vicinity of the project
    - c. Location of on-site storm drain system and off-site storm drain inlets that could receive runoff from the project activities
    - d. Location of nearby creeks, wetlands or other receiving waters
  - 3. Expected pollutants to be generated or used during the project
  - 4. Describe the best management practices (BMPs) that will be employed for the duration of the project. At a minimum, the following BMPs shall be utilized:
    - a. Erosion control measures to reduce post-construction erosion, such as re-vegetation with local native plant species and installation of appropriate slope protection.
    - b. Provide and maintain all necessary erosion and sediment control measures throughout the construction period as required to minimize stormwater pollution control from the Contractor's work area. Erosion and sediment control measures may include, but are not limited to, straw bale dikes, sand bag dikes, silt fences, drainage swales, pipe drains, sediment traps, protective sheets, jute matting, hydro-seeding, and appropriate surface contouring. The Contractor shall notify the Owner's

Representative if erosion and sediment control measures do not operate properly and shall take all necessary protective action.

- c. The Contractor shall secure erosion control devices at the end of each work shift during the period from November 1 to April 30, or when rain is forecast prior to the next work day.
  - d. Grading activities shall be prohibited during the period when rain is falling and runoff is observed at the site. The Contractor shall immediately secure the site for erosion control and storm water runoff.
  - e. Prepare drainage ways that handle concentrated or increased runoff from disturbed areas by using riprap or other lining materials to control erosion.
  - f. Reduce erosion by limiting the area and time of exposure, and by the provision of diversion channels.
  - g. Use temporary plant cover, mulching, and/or structures to control runoff and protect areas subject to erosion during construction.
  - h. Minimize soil exposure during the rainy season by proper timing of grading and construction and be prepared to shut down all earthwork if heavy precipitation occurs.
  - i. Have erosion control equipment and materials on site if needed in an emergency to quickly construct temporary collectors, diversion channels, intercept drains, berms, dikes or filters.
  - j. Grading and permits and the appropriate environmental clearances shall be obtained by the Contractor prior to any export of materials off site.
  - k. The Contractor shall provide final stabilization and permanent BMPs for closeout of the project site.
- E. The Contractor shall prepare a hazardous materials spill prevention plan to be implemented during construction in the event a hazardous materials spill or release occurs. The hazardous materials spill prevention plan shall include the following:
- 1. Identification of individuals responsible for implementing control measures as well as personnel to contact in case of a hazardous materials spill.
  - 2. Identification of spill response procedures for small medium and worst-case events, as appropriate.
  - 3. Definition of safety measures for each kind of hazardous waste/materials used during project construction.
  - 4. Instructions for how to notify appropriate authorities, such as police and fire departments, and hospitals as needed and as applicable.
  - 5. Description of procedures approved by state and local governments for containing, diverting, isolating, and cleaning up spills.
  - 6. Description of spill response equipment to use, including safety and cleanup equipment, location of spill kits, and proper disposal methods for used materials.
  - 7. Standard spill kits shall be present on the project site during project construction activities.

8. For any spill, construction staff should avoid the use of water for cleaning to prevent contaminated water from reaching storm drains; dry spills can be swept up while wet spills can be contained and absorbed using the equipment included in standard spill kits

### **1.11 Construction Cleaning**

- A. The Contractor shall, at all times, keep property on which work is in progress and the adjacent property free from accumulations of waste material or rubbish caused by employees or by the Work. All surplus material shall be removed from the site immediately after completion of the work causing the surplus materials. Upon completion of the construction, the Contractor shall remove all temporary structures, rubbish, and waste materials resulting from its operations.

### **1.12 Disposal of Material**

- A. The Contractor shall make arrangements for disposing of materials outside the Site and the Contractor shall pay all costs involved.
  1. The Contractor shall first obtain permission from the property owner on whose property the disposal is to be made and absolve the Owner from any and all responsibility in connection with the disposal of material on said property.
  2. When material is disposed of as above provided, the Contractor shall conform to all required codes pertaining to grading, hauling, and filling of earth.

### **1.13 Parking and Storage Areas**

- A. All stockpiled materials and parked equipment at the job site shall be located to avoid interference with private property and to prevent hazards to the public.
- B. Locations of stockpiles, parking areas, and equipment storage must be approved by the Owner's Representative.

### **1.14 Traffic Regulation**

- A. General
  1. The Contractor shall be responsible for maintenance of public safety and traffic control.
  2. The Contractor shall take all necessary steps to minimize inconvenience to the general public throughout all work under this Contract.
    - a. No driveways or private roads shall be blocked without notifying the property owner and access must be restored during all non-working hours.
    - b. Safe access must be maintained for pedestrian traffic throughout the work area at all times.
  3. At least one lane of traffic in each direction must be kept open at all times unless prior approval is provided by the Owner and any affected agency.
  4. No roads shall be blocked or made inaccessible, due to the Contractor's work, without prior written approval of the Owner and the affected agencies.
  5. The Contractor shall not block or obstruct fire lanes at any time.

- B. Haul Routes

1. Prior to the pre-construction conference, the Contractor shall submit for approval the proposed route(s) for all construction traffic on the project. This shall include any designated routes, if any, shown on the Contract Drawings. Upon approval, the Contractor shall strictly adhere to that route(s) only, unless written permission is obtained to change the route(s).

#### C. Traffic Control

1. Traffic control shall be in accordance with the California Department of Transportation Traffic Manual. The Contractor shall submit for approval, by the Owner and any other applicable agency, its traffic control plans prior to work on public streets.
2. Traffic control shall include signs, warning lights, reflectors, barriers, and other necessary safety devices and measures, including sufficient flaggers to direct vehicular traffic through the construction areas.
3. No material or equipment shall be stored/parked where it will interfere with the free and safe passage of public traffic, and at the end of each day's work, and at other times when construction operations are suspended for any reason, the Contractor shall remove all equipment and other obstructions from the public right-of-way.
4. Should the Contractor appear to be negligent in furnishing warning and protective measures, as above provided, the Owner's Representative may direct attention to the existence of a hazard, and the necessary warning and protective measures shall be furnished and installed by the Contractor at its expense.

#### **1.15 Biological Resources Protection**

- A. The Contractor shall obtain tree removal permits from Calaveras County prior to the removal of tree and shrubs on the project site.
- B. Prior to commencing construction, the Contractor shall attend biological resources preconstruction training with CCWD staff to review project design conditions relating to biological resources.
- C. The Contractor shall comply with the following biological resources protection measures to protect migratory and/or special status birds:
  1. If possible, complete tree removal during the non-breeding season (September 1 through January 31).
  2. If tree removal is scheduled during the nesting season (February 1 to August 31), a preconstruction survey for nesting birds shall be conducted by a qualified biologist within 7 days from the start of construction activities. The survey shall be conducted within the project impact area and a 250-foot radius. The Contractor shall hire this biologist at no additional cost.
  3. If the preconstruction survey does not identify any active nests, work may proceed.
  4. If the preconstruction survey identifies any active nests, an appropriate no-work buffer shall be established by a qualified biologist. The size of the buffer shall be determined based on the proximity of the active nest to work activities, ambient noise levels, and other factors determined relevant by the qualified biologist (e.g., line of sight). The no-work buffer zone shall be delineated by highly visible temporary construction fencing, which shall remain in place and maintained in good condition until the nest is no longer

active, as determined by a qualified biologist. The Contractor shall establish this buffer zone at no additional cost.

### **1.16 Cultural Resources Protection**

- A. Prior to commencing construction, the Contractor shall attend cultural resources preconstruction training with CCWD staff to review project design conditions relating to cultural resources.
- B. Contractor shall notify Owner one week prior to commencement of construction activities where native soils would be disturbed. Owner will contact local tribe to schedule monitoring. Monitoring will be limited to construction activities where native soils would be disturbed.
- C. If historical, archeological or paleontological artifacts are discovered, all work must stop in the immediate vicinity. The Contractor shall protect the discovered items, notify the Owner's Representative, and comply with applicable law.
- D. If human remains are discovered, all work must stop in the immediate vicinity of the find, and the County Coroner must be notified, according to Section 5097.98 of the State Public Resources Code and Section 7050.5 of California's Health and Safety Code.
- E. If the remains are determined to be Native American, the coroner will notify the Native American Heritage Commission, and the procedures outlined in CEQA Section 15064.5(d) and (e) shall be followed.

### **1.17 Project Sign**

- A. The Contractor shall provide, install and maintain for the duration of the project a project sign as designated below. The sign shall be installed within seven (7) days of Notice to Proceed and shall be installed where directed by the Owner's Representative.
  - 1. 8'x4' exterior grade plywood, minimum 3/4" thick
  - 2. Two coats exterior quality paint for background, one coat exterior quality paint for lettering.
  - 3. Erect supports and framing on secure foundation, rigidly braced and framed to resist loadings. Install sign surface plumb and level; anchor securely.
  - 4. Colors of sign shall be as designated by the Owner's Representative.
  - 5. Remove sign at the end of the project.
- B. Contents of Project ID Sign
  - Project Name: Wastewater Treatment and Reclamation Plant Improvement Project
  - Owner: Calaveras County Water District
  - Engineer: HydroScience Engineers, Inc.
  - Owner's Representative: N/A
  - Construction Cost: TBD
  - Start Date: TBD
  - Estimated End Date: TBD

### 1.18 Project Office

- A. The Contractor shall maintain on the project site a suitable office or other protected area in which shall be kept project copies of the Contract Documents, project progress records, project schedule, shop drawings, and other relevant documents which shall be accessible to the Owner and Owner's Representative during normal working hours.

### 1.19 Owner's Representative's Office

- A. The Contractor shall provide and furnish at its own expense, a temporary Owner's Representative's office. The Contractor shall relocate, install and make operational the Owner's Representative office the first day that the Contractor starts work at the project site, in a location as directed by the Owner's Representative. Unless the Contractor is directed by the Owner's Representative to remove the office at an earlier date, the office shall be disconnected from the utilities between twenty and thirty-five days after the Notice of Completion is recorded. The Contractor shall be responsible for removal of the trailer from the site.
- B. The Trailer shall be furnished at the District's expense if the Trailer is to remain in operation after Construction for the District's future use. The Trailer shall be cleaned by the Contractor prior to substantial completion and repaired as necessary due to construction related damage.
- C. Trailer shall be of standard frame mobile construction with interior and equipment to include:
  - 1. Trailer size shall be approximately 10'x36' or manufacturer's next standard size, it shall include two locking exterior solid metal clad doors with keys, two offices, conference room and a bathroom.
  - 2. Steel or timber steps to match the entrances of the office shall be constructed.
  - 3. Interior Lighting: double fluorescent fixtures complete with tubes and diffusers (1 fixture per every 100sqft).
  - 4. Outside Lighting: single night light mounted over each entry door.
  - 5. HVAC equipment: Air conditioning and heating unit capable of maintaining a comfortable working environment at all times.
  - 6. Electrical service: 200-ampere, 120/240 volt.
  - 7. Washroom: Lavatory, water closet with paper towel and toilet tissue holders.
    - a. Provide and furnish potable water connection for washroom.
- D. Contractor shall maintain 30'x10' by 6" thick aggregate base parking area in front of the Owner's Representative's trailer
- E. Furniture and Equipment:
  - 1. All furniture provided shall be of new or rental furniture in good condition may be substituted.

Description	Number
-------------	--------

Flattop Desks 30 in by 60 in double pedestal	1
Four drawer files, legal size, commercial grade	1
Leg Table 30 in by 60 in	2
Swivel Chair with armrests and wheels	1
Side Chair, no arms	8
Plan Rack 12 binders and brackets	1
Storage Cabinet 72 in by 36 in by 18 in, four shelves	1
Multi-functional/all in one printer/scanner/fax machine, with max legal size capability	1
Waste Paper Baskets 12in diameter	4

- F. Two fire extinguishers shall be provided for trailer, UL approved Class B, C min. 2 lb size.
- G. The Contractor shall provide, at its cost, electrical service to the office, including an adequate disconnect switch.
- H. The Contractor shall arrange, at its cost, with the local utility to provide temporary telephone and high speed internet service at a mutually agreeable location in the Owner's Representative's trailer.
- I. The Contractor shall provide bottled water service with hot and cold water dispenser to the Owner's Representative trailer for the duration of the project.
- J. A holding tank or similar device shall be installed and connected for sanitary sewage. The Contractor shall pump the holding tank as necessary during the duration of the job.
- K. The Owner's Representative shall be responsible for paying for the monthly power and telephone service.
- L. Contractor shall be responsible for all maintenance and repair of the structural facilities including access stairs, trailers, trailer supports and skirting, plumbing, electrical, ventilating systems and all other appurtenances. Contractor shall arrange for prompt service for the maintenance and repair with either his own forces or with service contract agreements for the trailer leasing company.
- M. At the end of construction, the trailer and all its furnishings, connections and appurtenances shall be removed and become property of the Contractor.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

## **SECTION 01540 SECURITY**

### **PART 1 - GENERAL**

#### **1.01 General**

- A. The Contractor shall safely guard all work, materials, equipment and property from loss, theft, damage and vandalism. Contractor's duty to safely guard property shall include the Owner's property and other private property from injury or loss in connection with the performance of the Contract.
- B. The Contractor may make no claim against the Owner for damage resulting from trespass.
- C. The party responsible for security shall make good all damage to property of Owner and others arising from failure to provide adequate security.
- D. Security measures taken by the Contractor shall be at least equal to those usually provided by the Owner to protect the existing facilities during normal operation.
- E. A security program shall be maintained throughout construction until final acceptance and occupancy precludes need for Contractor's security program.
- F. Fire Extinguishers
  - 1. Sufficient number of fire extinguishers of the type and capacity required to protect the Work and ancillary facilities, shall be provided and maintained in readily accessible locations.
- G. Temporary Fences
  - 1. Except as otherwise provided, the Contractor shall enclose the site of the Work with a fence adequate to protect the Work and temporary facilities against acts of theft, violence, or vandalism.
  - 2. In the event all or a part of the site is to be permanently fenced, this permanent fence or a portion thereof may be built to serve for protection of the Work site, provided however, that any portions damaged or defaced shall be replaced prior to final acceptance.
  - 3. Temporary openings in existing fences shall be protected to prevent intrusion by unauthorized persons. During night hours, weekends, holidays, and other times when no work is performed at the site, the Contractor shall provide temporary closures or guard service to protect such openings. Temporary openings shall be fenced when no longer necessary.
  - 4. If existing fencing or barriers are breached or removed for purposes of construction, the Contractor shall provide and maintain temporary security fencing equal to the existing in a manner satisfactory to the Owner's Representative.

#### **1.02 Contractor's Access to the Site**

- A. Access to the project site for Contractor's employees, material, tools, and equipment shall be via the main entrance to the Arnold WWTF as designated by the Owner's Representative and as shown on the Drawings.
- B. The Contractor shall ensure that each of its employees, representatives, material men, suppliers and others acting for the Contractor shall be subject to the following:
  - 1. No Contractor employee's personal vehicle shall be allowed to park anywhere other than the Contractor Employee's Parking Area.
  - 2. The Area shall be designated by the Owner's Representative.

3. The Contractor shall prepare and maintain this area as required.
- C. The Contractor shall obtain and follow all security measures and procedures as outlined by the Owner and Police Departments.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

## **SECTION 01610 SEISMIC ANCHORAGE AND BRACING**

### **PART 1 - GENERAL**

#### **1.01 Section Includes**

- A. Requirements for seismic anchorage and bracing for equipment, pipe, ducts, conduit and other nonstructural components.

#### **1.02 Referenced Sections**

- A. The following Sections are referenced in this Section
  - 1. Section 01611 – Seismic Requirements
  - 2. Section 05501 – Anchor Bolts and Anchoring Devices

#### **1.03 Areas of Design Responsibility**

- A. The Contractor shall:
  - 1. Design seismic attachments, braces, and anchors to the structure for tanks, mechanical equipment and electrical equipment included in the Work that weigh more than 20 pounds.
  - 2. Provide Seismic Anchorage and Bracing Calculations for all other equipment, and piping systems. This includes but is not limited to all above grade pipe.
  - 3. Provide submittals for anchorage and bracing of all equipment
  - 4. Equipment manufacturers shall provide design calculations and details for their specific pieces of equipment as part of the submittal for that equipment.
  - 5. Anchor bolts and concrete and masonry anchors for the anchorage of equipment will be provided by the Contractor in accordance with the bolt sizing, minimum embedment, and spacing requirements determined by the calculations. Anchor bolts and concrete and masonry anchors are part of the Contractor's scope of supply.

#### **1.04 References**

- A. The following is a list of standards which may be referenced in this section.
  - 1. International Code Council (ICC)
  - 2. California Building Code (CBC)
  - 3. Evaluation Service (ICC-ES) Reports and Legacy Reports
  - 4. American Society of Civil Engineers (ASCE): ASCE 7, Minimum Design Loads for Building and Other Structures.

#### **1.05 Submittals**

- A. Seismic Anchorage and Bracing Calculations
  - 1. Submit manufacturer's engineered seismic hardware data and installation requirements.

2. Provide calculations for seismic attachments, braces and anchorages clearly showing the criteria used for the design. Calculations for anchorage of components shall be sealed by a California registered Structural or Civil Engineer.
- B. Shop Drawings: Show details of seismic attachment assemblies including connection hardware, bracing, and anchor bolts.

### **1.06 Design and Performance Requirements**

- A. In accordance with CBC, tanks, mechanical and electrical components, and other elements of the Work that are permanently attached to structures shall be designed and constructed to transfer the component seismic forces specified in ASCE 7, Chapter 13 to the structure.
- B. Seismic attachments, braces, and anchorages shall be designed in accordance with the provisions of the California Building Code and the site-specific criteria in Section 01611.
- C. Comply with Section 11300.

## **PART 2 - PRODUCTS**

### **2.01 Materials**

- A. Attachments and supports transferring seismic loads to the structure shall be constructed of materials and products suitable for the application and designed and constructed in accordance with the design criteria shown on the Drawings and nationally recognized standards.
- B. Powder driven fasteners and sleeve anchors shall not be used for seismic attachments and anchorage where resistance to tension loads is required.
- C. Anchor Bolts: In accordance with Section 05501.

## **PART 3 - EXECUTION**

### **3.01 General**

- A. Design seismic anchorage systems to provide restraint in all directions, for each component or system so anchored.
- B. Tall and narrow equipment such as motor control centers and electrical control panels shall be anchored at the base and within 12 inches from the top of the equipment.
- C. Mechanical and electrical components shall not be attached to more than one element of a building structure at a single restraint location where such elements may respond differently during a seismic event. Such attachments shall also not be made across building expansion and contraction joints.
- D. Seismic attachments, braces, anchor bolts, and concrete and masonry anchors shall be provided and installed by the Contractor in accordance with the size and number of braces determined by the calculations.

**\*\*END OF SECTION\*\***

# **SECTION 01611 SEISMIC DESIGN REQUIREMENTS**

## **PART 1 - GENERAL**

### **1.01 Section Includes**

- A. The following primary and secondary structural system elements, non-structural components, and/or equipment supported by structures.
  - 1. Mechanical, electrical, and plumbing equipment and appurtenances.
  - 2. Conduit, piping, cable trays, raceways, ducts and similar systems.
  - 3. Tanks and vessels (include contents), including support systems.
  - 4. Storage racks, suspended ceilings, light fixtures, raised floors, partitions, store-fronts, windows, louvers, architectural features and other non-structural components.

### **1.02 Referenced Sections**

- A. The following Sections are referenced in this Section
  - 1. Section 05501 – Anchor Bolts and Anchoring Devices

### **1.03 References**

- A. 2019 California Building Code (CBC)
- B. ASCE 7-16 Design Loads for Buildings and Other Structures

### **1.04 Definitions**

- A. Engineer of Record: The Engineer responsible for the preparation of Contract Documents.
- B. Specialty Engineer: Structural or Civil Engineer provided by the Contractor licensed in the State where the project is being built responsible for specific elements of the primary structural system, the secondary structural system, non-structural elements and/or equipment supported by structures.

### **1.05 General Design Requirements**

- A. The seismic design for non-structural components and equipment shall be in accordance with the CBC Chapter, ASCE 7, and the required coefficients and factors for determining the total design seismic forces are provided in the Seismic Design Criteria in Paragraph D below.
- B. Coordinate the layout so that adequate space is provided between items for relative motion. Provide additional supports and restraints between items of different systems when necessary to prevent seismic impacts or interaction.
- C. Seismic forces shall be determined in accordance with the following seismic design criteria:
  - 1. Site-Specific Spectral Response Coefficients
    - a. Short Period Design Spectral Response Acceleration, 5 percent Damped:  $S_{DS} = .39 g$  (where  $g$  is acceleration from gravity)
    - b. 1 Second Period Design Spectral Response Acceleration, 5 percent Damped:  $S_{D1} = 0.28$

2. Site Class: D
3. Importance Factor:  $I_e = 1.5$
4. Seismic Design Category: D, unless noted otherwise
5. Risk Category: IV, unless noted otherwise
6. Component Importance Factor,  $I_p$ :
  - a. Mechanical and Electrical Equipment: Use 1.5.
  - b. Tanks and Tank Anchorage: Use 1.5.
  - c. Components that contain hazardous materials: Use 1.5.
  - d. Components that are required for life safety: Use 1.5.
  - e. Components that must remain functional after an earthquake, such as fire protection sprinkler systems: Use 1.5.
7. Do not use more than 60 percent of the weight of tanks and mechanical and electrical equipment for designing anchors for resisting overturning due to seismic forces.
8. Do not use friction to resist sliding due to seismic forces.

#### **1.06 Design Requirements for Piping, Conduit, and Ducts**

- A. The Contractor is responsible for producing designs for support of piping, conduit, duct or other systems to resist total seismic forces based on the seismic design criteria coefficients specified above, unless shown on the Contract Documents. Except where the technical specifications give specific exemption from resistance of seismic forces, all supports shall be designed to meet seismic criteria.
- B. Where possible, pipes, conduit, and their connections shall be constructed of ductile materials (e.g., copper, ductile iron, steel or aluminum and brazed, welded or screwed connections). Pipes, conduits and their connections, constructed of nonductile materials (e.g., cast iron, no-hub pipe and plastic), shall have the brace spacing reduced to one-half of the spacing allowed for ductile material.
- C. Seismic restraints may be omitted for the following conditions, where flexible connections are provided between components and the associated ductwork, piping and conduit:
  1. Fuel piping less than 1-inch inside diameter.
  2. All other piping less than 2.5-inches inside diameter or all piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the structural support for the hanger or electrical conduit less than 2.5-inches trade size.
  3. All rectangular air-handling ducts less than 6 square feet in cross-sectional area or all round air-handling ducts less than 28-inches diameter or all ducts suspended by individual hangers 12 inches or less in length from the top of the duct to the bottom of the structural support for the hanger, where the hangers are detailed to avoid bending of the hangers and their connections.
- D. All trapeze assemblies supporting pipes, ducts and conduit shall be braced to resist the total seismic forces considering the weight of the elements on the trapeze. Pipes, ducts and conduit supported by a trapeze where none of those elements would individually be braced need not be braced if connections to the pipe/conduit/ductwork or directional changes do not restrict the movement of the trapeze. If this flexibility is not provided, bracing will be required when

the aggregate weight of the pipes and conduit exceed 10 pounds/foot. The weight shall be determined assuming all pipes and conduit are filled with water.

- E. As an alternative to designing the supports and anchorage, where an approved national standard provides a basis for the earthquake-resistant design, submit standard, data, and details for piping, conduit, duct or other systems:
  - 1. For ductwork, mechanical piping, process piping and electrical conduits, follow Guidelines for Seismic Restraints of Mechanical Systems by SMACNA modified as follows:
    - a. Seismically brace piping regardless of size or location. Provide transverse braces at all changes in direction and at the end of all pipe runs. Space transverse braces not more than 20 feet apart. Provide longitudinal braces at 40-foot centers.
    - b. Seismically brace all ductwork regardless of size or location. Provide transverse braces at all changes in direction and at each end of run. Space braces not over 20 feet apart. Provide longitudinal braces at 40-foot centers.
  - 2. For fire protection systems, follow NFPA 13 modified as in Paragraph 1.b above. Ensure that no seismic interaction occurs with items of other systems.

### **1.07 Design requirements for Underwater Items**

- A. To allow for water sloshing, design rigid items such as piping or equipment supports for twice the lateral force, computed as if the item were above water.
- B. Design flexible items to accommodate sloshing motions without damage to rigid machinery.
- C. Provide retainers to hold items from falling and damaging rotating equipment below, if bolted connections will fail because of ground motion displacing the supports.

### **1.08 Submittals**

- A. Shop Drawings
  - 1. Submit signed and sealed structural calculations and detailed drawings for the following listed elements and where required in Divisions 2 through 16 of the primary structural system and their attachments, the secondary structural system and their attachments, permanent non-structural components and their attachments, and the attachments and anchorage for all permanent equipment supported by the structures.
- B. Structural calculations and detailed drawings shall be prepared by a Specialty Engineer licensed in the State where the project is being built.
- C. Structural calculations and detailed drawings shall clearly show the total design seismic forces which will be transferred from the elements of the structural system, non-structural components, and/or equipment and their attachments to the primary structure.
- D. The Engineer's review of items within a Specification Section cannot be completed until all related items have been coordinated and submitted for review.
- E. Quality Assurance Submittals
  - 1. Test Reports: Submit test reports for tension testing of anchors.
  - 2. Where required in the equipment specifications in Divisions 2 through 16 submit certification that the equipment itself is designed to resist all internal seismic forces based on the seismic design criteria for the project.

3. Where required in the equipment specifications in Divisions 2 through 16, submit signed and sealed structural calculations and detailed drawings from a specialty Structural or Civil Engineer licensed in the State where the project is being built for the attachments and anchorage to the primary structure.
4. Where required in the equipment specifications in Divisions 2 through 16, submit certification that the attachments and anchorage are designed to resist all seismic forces based on the seismic design criteria for the project.

### **1.09 Quality Assurance**

- A. Qualifications: Contractor is responsible for submitting signed and sealed structural calculations and detailed drawings from a Specialty Structural or Civil Engineer licensed in the State where the project is being built.
- B. Regulatory Requirements: Comply with the State of California adopted and amended versions of 2007 California Building Code (CBC) Chapter 16 - Earthquake Design plus clarifications and additions specified in this Section.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.01 Field Quality Control**

- A. Site Tests: Tension testing of expansion or adhesive anchors utilized for anchorage shall be done in the presence of the special inspector and a report of the test results shall be submitted. See Specification Section 05501 for additional requirements.
- B. Inspection: Special inspection shall be provided for high strength bolting or bolts installed in concrete. See Specification Section 05501 for additional requirements.

**\*\*END OF SECTION\*\***

## **SECTION 01615 WIND DESIGN CRITERIA**

### **PART 1 - GENERAL**

#### **1.01 Section Includes**

A. Wind design criteria.

#### **1.02 References**

A. International Code Council (ICC):

1. 2019 California Building Code (CBC).
2. ASCE/SEI 7-16 Minimum Design Loads for Buildings and Other Structures.

#### **1.03 Design Criteria**

A. Design in accordance with the requirements of the following:

1. Risk Category: IV
2. Basic Wind Speed:  $V = 105$  mph.
3. Wind Exposure Category: C
4. Wind Importance Factor:  $I_w = 1.0$
5. Topographic Factor:  $K_{zt} = 1.0$

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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## **SECTION 01660 TESTING AND STARTUP**

### **PART 1 - GENERAL**

#### **1.01 Description**

A. This Section provides specifications for the installation and testing of all mechanical and electrical systems; and processes. Additional testing requirements for equipment, piping, structures, instrumentation, control, and electrical systems are included in other Sections. All commissioning work for the equipment installed under this Contract shall be performed by the Contractor.

#### **1.02 Definitions**

- A. Facility: Entire project, or agreed upon portion including all relevant unit processes.
- B. Unit Process: A portion of the facility that performs a specific process function.
- C. Functional Checkout: Tests to demonstrate that installed equipment meet's manufacturer's installation, calibration, and adjustment requirements; electrical and control system requirements; and other requirements as specified.
- D. Performance Test: Service water test of a unit process or group of unit processes to demonstrate that the system(s), including equipment, instrumentation, controls, electrical, and auxiliary components function to meet the requirements of the Contract Documents.
1. Duration of Performance Test: Continuous, uninterrupted period of not less than 7 days.
- E. Demonstration Period: Period of initial operation and shakedown after commissioning, seeding and startup of the facility or portion of a facility used to further demonstrate that the facility operation under actual loading conditions and to identify issues not readily apparent or discovered during previous testing.
1. Duration of Demonstration Period: Continuous Period of not less than 14 days.

#### **1.03 Submittals**

- A. The following shall be submitted in compliance with Section 01300 – Submittals.
- B. Startup and Testing Plans:
1. Submit the following plans:
    - a. Functional Checkout Plan
      - 1) For the Secondary Clarifier, include:
        - a) Hydrostatic Testing Plan
        - b) Service Water Testing Plan
    - b. Performance Test Plan
    - c. Demonstration Period Plan
  2. Describe all procedures and schedule for project testing, commissioning and startup.
  3. Once the Test Plans have been reviewed and accepted by the Owner's Representative, the Contractor shall produce checkout, alignment, adjustment and calibration sign-off forms for each item of equipment.

- a. The forms will be used in the field by the Contractor and the Owner's Representative jointly to ensure that each item of electrical and mechanical equipment has been properly installed and tested.
  4. Submit at least 60 days prior to beginning startup activities.
  5. Provide testing plan with test logs for each item of equipment or each system to be tested.
  6. Provide regular updates of testing and commissioning schedule. Submit on a weekly basis a 14 day look-ahead schedule at the time of testing.
- C. Test Reports:
1. Submit reports of:
    - a. Functional Checkout
    - b. Performance Test
    - c. Demonstration Period
  2. Results in a tabular format acceptable to the Engineer.
  3. Submit certification of calibration of all instrumentation, including testing equipment before the Performance Test.

#### **1.04 Quality Assurance**

A. Installation:

1. All mechanical and electrical equipment furnished under this contract shall be installed in conformity with the details shown and specified and to the manufacturer's requirements.
2. Should a manufacturer's installation requirements conflict with specific requirements of the contract documents, the Contractor shall bring the matter to the attention of the Owner's Representative.
3. Any additional costs incurred arising out of changes authorized by the Owner's Representative to accommodate manufacturer's installation requirements will not be considered extra work.
4. Any costs, or time, incurred by the Contractor through failure to timely notify the Owner's Representative of a difference between contract documents and manufacturer's installation requirements shall be borne by the Contractor.

B. Testing:

1. General Requirements:
  - a. All materials, equipment, and work included in this contract shall be tested and inspected to ensure compliance with the contract requirements.
  - b. Unless otherwise specified, all costs of testing, including temporary facilities and connections, shall be borne by the Contractor.
  - c. For the purpose of this section, equipment shall mean any mechanical, electrical, instrumentation, or other device with one or more moving parts or devices requiring an electrical, pneumatic or hydraulic connection. Installed tests for equipment, piping, structures, instrumentation, control, and electrical systems are also included in other Sections.
2. No tests specified herein shall be applied until the item to be tested has been inspected and approval by the Owner's Representative has been given for the application of such tests.
3. Tests and inspections, unless otherwise specified or accepted, shall be in accordance with the recognized standards of the industry.

4. The form of evidence of satisfactory fulfillment of all test and inspection requirements shall be, at the discretion of the Owner's Representative, either by tests and inspections carried out in the Owner's Representative's presence or by certificates or reports of tests and inspections carried out by approved persons or organizations.
5. The Contractor shall provide and use forms which include all test information, including specified operational parameters, and which shall be acceptable in content to the Owner's Representative.

#### **1.05 Tests and Inspection:**

##### **A. General:**

1. All equipment shall be tested by the Contractor and the equipment manufacturers' representatives to the satisfaction of the Owner's Representative before any facility is put into operation.
2. Tests shall be as specified herein and as recommended by the manufacturer to determine whether the equipment has been properly assembled, aligned, adjusted and connected.
3. Any changes, adjustments or replacements required to make the equipment operate as specified shall be carried out by the Contractor as part of the Work.

##### **B. Procedures:**

1. Prior to receipt of any progress payments in excess of 60 percent of the Contractor's lump sum bid for the work, the Contractor shall submit to the Owner's Representative, details of the procedures for testing and start-up of all equipment to be operated singly and together, excepting when such procedures have been covered in the specifications.
2. The procedures shall be divided into three distinct stages; Functional Checkout, Performance Tests, and Demonstration Period.
3. Testing procedures shall be designed to duplicate, as nearly as possible, all conditions of operation and shall be carefully selected to ensure that the equipment is not damaged.
4. Failure to observe these procedures may result in the non-acceptance of the subject equipment in question.

##### **C. Test results shall be within the tolerances set forth in the detailed specification sections of the contract documents and any manufacturer's required specifications.**

1. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice.
2. Where, in the case of an otherwise satisfactory installed test, any doubt, dispute, or difference should arise between the Owner's Representative and the Contractor regarding the test results or the methods or equipment used in the performance of such test, then the Owner's Representative may order the test to be repeated.
3. If the repeat test, using such modified methods or equipment as the Owner's Representative may require, substantially confirms the previous test, then all costs in connection with the repeat test will be paid by the Owner; otherwise the costs shall be borne by the Contractor.
4. Where the results of any installed test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by and at the expense of the Contractor

##### **D. At a minimum the following test data shall be collected:**

1. Operating voltages and amperages per phase.
2. Motor inrush current.

3. Operating pressures.
4. Operating flows.
5. Operating temperature.
6. Analog inputs and outputs during test.
7. Analytical instruments outputs during test.
8. Alarm conditions.

E. Records and Forms:

1. The Contractor shall provide signoff forms for all testing to be accomplished under this contract.
2. Sign off forms shall be provided for each item of mechanical, electrical and instrumentation equipment provided or installed under this contract and shall contain provisions for recording relevant performance data for original testing and not less than three retests.
3. Separate sections shall be provided to record values for the Functional Checkout, Performance Test, initials of representatives of the equipment manufacturers, the Contractor and the Owner's Representative.
4. Upon completion of testing, the Contractor shall furnish the Owner's Representative with the original of the sign off sheet for each equipment item.

**1.06 Functional Checkout:**

- A. The procedures shall incorporate all requirements of these specifications and shall proceed in a logical, step-wise sequence to ensure that all equipment has been properly serviced, aligned, connected, calibrated, and adjusted prior to operation.
- B. Functional Checkout procedures shall include, but not necessarily be limited to:
1. Electrical system testing.
  2. Instrumentation and controls testing.
  3. Piping system pressure testing and cleaning.
  4. Alignment of equipment.
  5. Initial lubrication of equipment.
  6. Cleaning of tanks, channels, basins, and all structures.
  7. Written certification by the manufacturer that the equipment has been installed in accordance with the manufacturer's instructions, requirements and recommendations; that the equipment is ready for operation and that the Owner's staff is suitably instructed in operation and maintenance of the equipment.

**1.07 Manufacturer's Field Services and Certification:**

A. Field Services:

1. The manufacturer shall perform field services on each equipment item.
2. Inspect system before initial start-up and certify that system has been correctly installed and prepared for start-up.
3. After the installation of the units and all appurtenances, each unit shall be subjected to a field running test under actual operating conditions. The field tests shall be made by the Contractor in the presence of and as directed by the Owner's Representative. The field tests shall demonstrate that under all conditions of operation each unit:

- a. Has not been damaged by transportation or installation
  - b. Has been properly installed
  - c. Has no mechanical defects
  - d. Is in proper alignment
  - e. Has been properly connected
  - f. Is free of overheating of any parts
  - g. Is free of all objectionable vibration
  - h. Is free of excessive noise
  - i. Is free of overloading of any parts
  - j. Shall operate as specified with the control system
  - k. Meets the performance requirements indicated
4. Any defects in the equipment or failure to meet the requirements of the Specifications shall be promptly corrected by the Contractor.

**B. Manufacturer's Certification:**

1. The Contractor shall submit certification letters for all equipment per requirements of Contract Documents.
2. Each letter shall be submitted on the manufacturer's letterhead and shall include the following statements that:
  - a. The signer has visited the site, inspected the equipment and installation, and certifies that the equipment is ready for operation.
  - b. The equipment has been installed in accordance with the manufacturer's requirements and is properly aligned and ready for operation.
  - c. The equipment has been serviced, lubricated and properly prepared to perform in accordance with the intent of the Contract Documents.
  - d. The controls, protective devices, instrumentation, and control panels furnished, as part of the equipment package, are properly installed, calibrated, and are ready for full time operation.
  - e. The control logic for startup, shutdown, sequencing, interlocks, remote operation, and emergency shutdown have been tested and are functioning properly.
  - f. The training of the Owner's operations and maintenance personnel has been completed and note the date and time of that training.
  - g. The manufacturer certifies that the equipment is approved for operation.

**1.08 Performance Test:**

**A. Performance Test Requirements:**

1. The Performance Test shall demonstrate the entire process system including, piping, valves, gates, controls, instrumentation, and auxiliary systems function as intended.
2. All systems and components shall be operated as a complete facility at various flow conditions, as directed by the Owner's Representative.
3. All equipment and systems shall be operated, to the greatest extent practicable, at conditions which represent the full range of operating parameters as defined by the Contract Documents.

4. The equipment shall be operated to determine equipment operating characteristics, including temperatures and vibration; to observe performance characteristics; and to permit initial adjustment of operating controls.
5. Performance Test shall include remote PLC modes of operation, alarms, and shutdowns as required in the electrical, instrumentation and controls portions of the Contract Documents.
6. Install gratings, safety chains, handrails, shaft guards, walkways and sidewalks prior to Performance Test.
7. Install all required lighting, heating, ventilation, and air conditioning for areas and processes to be included in the Performance Test.

B. Performance Test Sequencing:

1. After completion of Functional Checkout and Manufacturer's Certification.
2. Contractor shall schedule and all appropriate parties 15 days prior to the start date of the performance test.
3. Contractor shall inspect and clean debris and dirt from all piping and structures.
4. Contractor shall fill all process units and liquid process systems, except those employing oil or chemicals, with either potable or recycled water, as directed by the Owner.
  - a. Unless otherwise specified, the Contractor shall provide at no expense to the Owner, all power, fuel, water, utilities, supplies, consumables, chemicals, testing media, labor and all other necessary items and work required to complete all tests specified in this section.
  - b. Coordinate with Owner's personnel for supply of test water.
  - c. Cost for testing water shall be per the Contract Documents.
  - d. All fuel and oil systems shall be filled with the specified fluid.
  - e. Test media for chemical systems shall be either the intended fluid or compatible substitute, as directed by the Owner's Representative.
  - f. Disposal methods for test media shall be subject to review by the Owner's Representative.
  - g. Contractor shall be responsible for costs for disposal of test media.
5. Upon completion of the filling operations, the Contractor shall circulate potable or recycled water, as designated by the Owner, through the completed facility for the duration of the Performance Test.
  - a. Contractor shall provide temporary pumping or piping required to recirculate water through the process units.
  - b. Remove temporary facilities after the completion of Performance Testing.

C. Performance Test Criteria

1. Performance testing shall be witnessed by all appropriate parties and include an itinerary and designated protocol which has been submitted and approved by the Engineer prior to Testing.
2. If successful, the performance testing will be signed off and Accepted by the following people, as a minimum:
  - a. The Owner,
  - b. The Design Engineer,
  - c. The Contractor,
  - d. The Owner's representative,

- e. Equipment representatives,
  - f. Any applicable persons or entities that have a vested stake in the Project or shall be assuming responsibility for the facility after construction.
3. Should the Performance Test period be halted for any reason related to the facilities constructed or the equipment furnished under this contract, or the Contractor's temporary testing systems, the Performance Test program shall be repeated until the specified continuous period has been accomplished without interruption.
  4. If, under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed or replaced; tests on that portion when so adjusted, altered, removed or replaced, together with all other portions of the work as are affected thereby, shall, if so required by the Owner's Representative, be repeated within reasonable time and in accordance with the specified conditions.
    - a. The Contractor shall pay to the Owner all reasonable expenses incurred by the Owner as a result of repeating such tests.
  5. At the conclusion of the Performance Test, the Contractor shall recheck all equipment for proper alignment, and if necessary, realign the equipment to manufacturer's standards or Contract requirements.
    - a. All equipment shall be checked for loose connections, unusual movement or other indications of improper operating characteristics.
    - b. Any deficiencies shall be corrected to the satisfaction of the Owner's Representative.
    - c. All equipment or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected.
    - d. Unacceptable equipment shall then be repaired or removed from the site and replaced at no cost to the Owner.

### **1.09 Demonstration Period:**

#### **A. General:**

1. Owner personnel will operate the facility with the assistance and coordination from the Contractor.
2. Demonstration Period shall commence when, in the opinion of the Owner's Representative, the following conditions have been met:
  - a. All equipment Functional Checkouts are complete.
  - b. Performance Testing is complete,
  - c. All Operations and Maintenance Manuals have been submitted, approved and copies have been transmitted to the Owner's operations staff.
  - d. All Operations & Maintenance training is complete.
  - e. All Manufacturer Certifications have been submitted.
3. Contractor shall schedule and notify the Owner 30 days prior to the start date of the Demonstration Period.
4. Contractor shall schedule process cut-overs or tie-ins with the Owner's Representative and Owner's operations staff.
5. Contractor shall make available its personnel, subcontractors, suppliers, and manufacturers' representatives for the entire Demonstration Period.

- a. Contractor personnel shall be onsite during normal working hours for the entire period to make necessary corrections and adjustments.
  - b. Contractor's electricians or electrical subcontractor shall be onsite during normal working hours for the entire period to make necessary corrections and adjustments.
  - c. SCADA and controls integrator shall be available to be onsite within 48 hours during the entire period to make corrections, modifications, and updates to the control system.
  - d. All other subcontractors, suppliers and manufacturer's representatives shall be available to be onsite within 48 hours during the entire period to make necessary corrections and adjustments.
6. Contractor shall provide emergency contact numbers to be available 24 hours/day during the Demonstration Period.
- B. Owner shall furnish:
1. Chemicals required for startup.
  2. Seeding material for all biological processes, if required, unless otherwise specified or shown.
  3. Operations staff to operate the facility with support of Contractor.
  4. Labor and materials required for laboratory testing.
- C. At the end of the Demonstration Period, the Owner may issue a Substantial Completion Certificate, if in the opinion of the Owner's Representative, the following conditions have been met:
1. Corrections or adjustment to the facility as required by the Owner, Owner's Representative or Engineer to assure a reliable and completely operational facility have been made.
  2. Test reports have been submitted, reviewed, and accepted as adequate.
  3. All other Contract requirements for Substantial Completion have been fulfilled by the Contractor to the satisfaction of the Owner, owner's Representative, and Engineer.

## **PART 2 - PRODUCTS**

### **2.01 Materials**

- A. Gages, Meters, Recorders and Monitors:
1. Gages, meters, recorders and monitors shall be provided by the Contractor as required to supplement or augment the instrumentation system provided under this contract to properly demonstrate that all equipment fully satisfies the requirements of the contract documents.
  2. All devices employed for the purpose of measuring the performance of the facility's equipment and systems shall be specifically selected to provide a level of certainty consistent with the variables to be monitored.
  3. All instruments shall be recently calibrated, and the Contractor shall be prepared at all times to demonstrate, through recalibration, the certainty of all instruments employed for testing purposes.
  4. Calibration procedures shall in accordance with applicable standards of ASTM, ISA and IEEE.
  5. The adequacy of all gages, meters, recorders and monitors shall be subject to review of the Owner's Representative.

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. Inspect and clean the equipment, connected piping and structures and remove debris and foreign material.
  - 1. Flush piping.
  - 2. Sweep or vacuum clean all channels and structures to remove fine material.
- B. Turn rotating equipment by hand to check for binding or other improper operation.
- C. Perform cold and hot alignment to the manufacturer's recommended tolerances.
- D. Remove rust preventatives, oils or temporary protective coatings used to protect the equipment during construction.
- E. Open and close adjacent valves by hand to check for proper seating and range of motion.
- F. Electrical systems:
  - 1. Complete insulation resistance tests on wiring.
  - 2. Perform grounding tests as required.
  - 3. Complete motor insulation resistance tests.
  - 4. Verify correct rotation of motors and equipment.
  - 5. Complete other requirements per electrical specifications.
- G. Instrumentation systems:
  - 1. Complete instrument calibration.
  - 2. Complete instrument loop tests.
  - 3. Test pneumatic systems for leaks.
  - 4. Verify all control signals, operation, ranges and settings.
  - 5. Complete other requirements per instrumentation and controls specifications.

### **3.02 Installation**

- A. All materials and equipment shall be installed by specialists properly skilled in the trades and professions required to assure first-class workmanship.
- B. Where required by detailed specifications, the Contractor shall cause the installation of specific equipment items to be accomplished under the supervision of factory-trained installation specialists furnished by the equipment manufacturers.
- C. The Contractor shall be prepared to document the skills and training of all workers engaged in the installation of all equipment furnished either by the Contractor or the Owner.

### **3.03 Testing**

- A. Testing shall proceed on a step-by-step basis in accordance with the Contractor's written testing procedures.
- B. The Contractor's testing work shall be accomplished by a skilled team of specialists under the direction of a coordinator whose sole responsibility shall be the orderly, systematic testing of all equipment, systems, structures and the complete facility as a unit.
- C. Each individual step in the procedures shall be witnessed by the Owner's Representative.

**\*\*END OF SECTION\*\***

## **SECTION 01661 INSTRUCTION OF OPERATORS AND MAINTENANCE PERSONNEL**

### **PART 1 - GENERAL**

#### **1.01 General**

- A. The Contractor shall provide the services of a factory trained maintenance specialist to instruct the Owner's operations and maintenance personnel in the recommended operation and the corrective and preventive maintenance procedures for equipment, as specified in the respective equipment sections.
- B. The qualifications of the specialist shall be subject to approval by the Owner's Representative.
- C. The Contractor shall be responsible for coordinating these services at times acceptable to the Owner's Representative, with a minimum of thirty (30) days prior notice.
- D. The Contractor shall provide a combination of classroom and field/machine shop training for each type of equipment. All classroom training shall be conducted at a location designated by the Owner's Representative.
- E. The Contractor shall allow the training session to be videotaped by the Owner.

#### **1.02 Submittals**

- A. The following shall be submitted in compliance with Section 01300 – Submittals.
- B. The Contractor shall submit for approval a proposed Lesson Plan for the instruction fourteen (14) days prior to commencement of scheduled training.
- C. The Contractor shall submit for approval credentials of their manufacturer's designated maintenance instructor. Credentials will include a brief resume and specific details of the instructor's experience with maintenance of and training on the equipment specified.

#### **1.03 Instruction Lesson Plan**

- A. The proposed Lesson Plan shall include the elements presented in the Outline of Instruction Lesson Plan below. Specific components and procedures shall be identified in the proposed Lesson Plan.
- B. The proposed Lesson Plan shall detail specific instruction topics. Training aids to be utilized in the instruction shall be referenced and attached where applicable to the proposed Lesson Plan. Hands-on demonstrations planned for the instruction shall be described in the Lesson Plan.
- C. The manufacturer shall indicate the estimated duration of each segment of the training Lesson Plan.
- D. The Contractor shall present an outline of the Instruction Lesson Plan, as follows:
  - 1. Equipment Operation
    - a. Describe equipment's operating (process) function.
    - b. Describe equipment's fundamental operating principals and dynamics.
    - c. Identify equipment's mechanical, electrical and electronic components and features.
    - d. Identify all support equipment associated with the operation of subject equipment (i.e., air intake filters, valve actuators, motors).
    - e. Provide standard operating procedures to cover start-up, routine monitoring and shut-down of the equipment.
  - 2. Detailed Component Description

- a. Identify and describe in detail each component's function.
  - b. Where applicable, group related components into subsystem. Describe sub-system functions and their interaction with other subsystems.
  - c. Identify and describe in detail equipment safeties and control interlocks.
3. Equipment Preventive Maintenance (PM)
- a. Describe PM inspection procedures required to:
    - 1) Perform an inspection of the equipment in operation.
    - 2) Spot potential trouble symptoms (anticipate breakdowns).
    - 3) Forecast maintenance requirements (predictive maintenance).
  - b. Define the recommended PM intervals for each component.
  - c. Provide lubricant and replacement part recommendations and limitations.
  - d. Describe appropriate cleaning practices and recommended intervals.
4. Equipment Troubleshooting
- a. Define recommended systematic troubleshooting procedures.
  - b. Provide component specific troubleshooting checklists.
  - c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
5. Equipment Corrective Maintenance
- a. Describe recommended equipment preparation requirements.
  - b. Identify and describe the use of any special tools required for maintenance of the equipment.
  - c. Describe component removal/installation and disassembly/assembly procedures.
  - d. Perform at least two hand-on demonstrations of common corrective maintenance repairs.
  - e. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
  - f. Define recommended torque, mounting, calibration and/or alignment procedures and settings, as appropriate.
  - g. Describe recommended procedures to check/test equipment following a corrective repair.

#### **1.04 Training Aids**

- A. The manufacturer's instructor shall incorporate training aids as appropriate to assist in the instruction. At a minimum, the training aids shall include text and figure handouts. Other appropriate training aids are:
- 1. Audio-Visual Aids (e.g., films, slides, videotapes, overhead transparencies, posters, blueprints, diagrams, catalogue sheets).
  - 2. Equipment Cutaways and Samples (e.g., spare parts, damaged equipment).
  - 3. Tools (e.g., repair tools, customized tools, measuring and calibrating instruments).
- B. The manufacturer's instructor shall utilize descriptive class handouts during the instruction. Photocopied class handouts shall be good quality reproductions. Class handouts should accompany the instruction with frequent reference made to them. Customized handouts developed

especially for the instruction are encouraged. Handouts planned for the instruction shall be attached with the manufacturer's proposed Lesson Plan.

#### **1.05 Hands-on Demonstrations**

- A. The manufacturer's instructor shall present hands-on demonstrations of common corrective maintenance repairs for each scheduled group.
  - 1. The manufacturer shall provide the tools and equipment to conduct the demonstrations.
  - 2. Requests for supplemental assistance and facilities should be submitted with the manufacturer's proposed Lesson Plan.
  - 3. The proposed hands-on demonstrations should be described in the manufacturer's proposed Lesson Plan.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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## **SECTION 01700 RESTORATION OF IMPROVEMENTS**

### **PART 1 - GENERAL**

#### **1.01 Structures**

A. The Contractor shall remove existing structures, including paving, sidewalks, curbs, gutters, pipelines, and rip rap, as may be necessary for the performance of the work and shall rebuild the structures thus removed in as good a condition as found with the requirements specified. Concrete structures such as curbs and gutters shall be replaced from joint to joint or as directed by the Owner's Representative. The Contractor shall also repair existing structures that may be damaged as a result of the work under this contract.

#### **1.02 Roads**

A. Unless otherwise specified, roads or other paved surfaces in which the surface is removed, broken, or damaged, or in which the ground has caved or settled during the work under this contract, shall be resurfaced and brought to the original grade and section. Requirements for paving restoration are covered in:

1. Section 02500 – Asphalt Concrete Paving
2. Section 03300 – Cast in Place Structural Concrete
3. Section 03310 – Cast in Place Sitework Concrete

#### **1.03 Cultivated Areas and Other Improvements**

A. Cultivated or planted areas and other surface or subsurface improvements, including irrigation systems, which are damaged by actions of the Contractor shall be restored as nearly as possible to their original condition at the Contractor's expense. Existing guard posts, barricades, and fences shall be protected and replaced if damaged. Contractor shall protect street lighting, traffic signals, telephone or other existing facilities from damage. Not all existing facilities are shown on the Drawings. Contractor shall restore all existing facilities damaged due to construction.

#### **1.04 Restoration of Existing Installations**

A. The Contractor shall, at no cost to the Owner, immediately correct or replace existing equipment, controls or systems that are damaged as a result of construction or Contractor operations.

#### **1.05 Warranty of Restoration Work**

A. The Contractor shall include all restoration work under the guarantee included in the General Conditions.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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## **SECTION 01710 FINAL CLEAN-UP**

### **PART 1 - GENERAL**

#### **1.01 Requirements**

- A. As a condition precedent to final acceptance or release of a structure, space or process unit for use by the Owner, the Contractor shall thoroughly clean all floors and walls to leave same in first-class condition.
- B. All pits and sumps shall be cleared of silt, sand, debris and construction materials. Ductwork, air intakes and exhaust grilles shall be inspected and cleared of extraneous material, and all grounds shall be cleared of all debris.
- C. At the completion of the project, the Contractor shall perform the following:
  - 1. Remove and dispose of all excess or waste materials, debris, rubbish, and temporary facilities from the site, structures and all facilities.
  - 2. Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to minimum condition specified.
  - 3. Remove spatter, grease, stains, fingerprints, debris, dust, labels, tags, packing materials and other foreign items or substances from interior and exterior surfaces, equipment, signs and lettering.
  - 4. Repair, patch and touch up chipped, scratched, dented or otherwise marred surfaces to match specified finish.
  - 5. Remove paint, clean and restore all equipment and material nameplates, labels and other identification markings.
  - 6. Wash and shine glazing and polished surfaces.
  - 7. Clean all floors, slabs, pavements, and ground surfaces.
  - 8. Maintain cleaning until acceptance by the Owner.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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## **SECTION 01720 RECORD DRAWINGS**

### **PART 1 - GENERAL**

#### **1.01 General**

- A. This Section describes the requirements for maintaining records of actual conditions in the field and for changes in the Work as contained on the As-Built drawings.
- B. As-Built drawings shall be transcribed to become the Project's Record Drawings. The purpose of the Project Record Drawings is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modifications of the work to proceed without lengthy and expensive site measurement, investigation, and examination.
- C. The Contractor shall provide the Owner's Representative neatly and legibly marked contract drawings showing the final horizontal and vertical location of piping, equipment, electrical conduits, outlet boxes and cables. Marking of the drawings shall be kept current and shall be done at the time the material and equipment are installed. These drawings shall be available to the Owner's Representative throughout the construction period. Final payment shall not be made until the marked up record drawings are delivered to and approved by the Owner's Representative.

#### **1.02 Documents Required**

- A. The following shall be maintained in the Contractor's field office in clean, dry, legible condition:
  - 1. Drawings,
  - 2. Specifications,
  - 3. Change Orders and other Modifications to the Contract Documents,
  - 4. Survey Data,
  - 5. Field Orders or Directives,
  - 6. Reviewed Shop Drawings, Product Data, and Samples,
  - 7. Testing Reports,
  - 8. Requests for Information,
  - 9. Claims,
  - 10. Training.

#### **1.03 Maintenance of Documents**

- A. Store record documents and samples in Contractor's field office apart from documents used for field construction purposes. Make documents and samples available at all times for inspection by the Owner's representatives.
- B. Update the documents within 24 hours after receiving information that a change has occurred or clarification has been issued.
- C. Drawings shall be updated weekly. Progress payments may be delayed until the Record As-Built drawings are updated to meet requirements and date of pay request.
- D. Record documents shall not be used for any other purpose and shall not be removed from the office without approval of the Owner's Representative.

## 1.04 Recording

- A. Label each document with “AS BUILT PROJECT RECORD” in neat, Large Printed lettering.
- B. Two, full-sized sets of the Contract Drawings will be furnished to the Contractor by the Owner. These Drawings shall be updated with record information and one copy of the updated record drawings shall be submitted for review to the Owner’s Representative every month. The Record Drawing shall be up-to-date and its completeness shall be a precondition of the next month’s partial payment request approval.
  - 1. Make annotations with erasable colored pencil conforming to the following color code:

<b>Annotations</b>	<b>Color</b>
Additions:	Red
Deletions:	Green
Comments:	Blue
Dimensions:	Graphite

- C. The Contractor may submit additional 24 X 36 sheets detailing record work as approved by the Owner’s Representative.
- D. Record information concurrently with the construction process.
  - 1. Do not conceal any work until required information is properly recorded and documented.
  - 2. Completely, accurately, and legibly record to the satisfaction of the Owner’s Representative, all deviations in construction, especially pipe and conduit locations, and any deviations caused by Approved changes and/or clarifications to the Work.
  - 3. Date all entries.
  - 4. Call attention to Record Drawing entries by drawings a “Cloud” around the affected area.
  - 5. Use different colors to designate overlapping changes.
- E. Legibly mark drawings to record actual construction:
  - 1. Identify location of spare conduits including beginning, ending and routing through pull boxes, and manholes. Record spare conductors, including number and size, within spare conduits, and filled conduits.
  - 2. Record actual depths, horizontal and vertical location of underground pipes, duct banks and other buried utilities. Reference dimensions to permanent surface features.
  - 3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.
  - 4. Depths of various elements in relation to finished work.
  - 5. Horizontal and vertical positions of underground utilities and appurtenances referenced to fixed surface improvements.
  - 6. Locations of internal utilities and appurtenances concealed in the construction, referenced to visible and accessible features of the structure.
  - 7. Field changes of dimension and detail.
  - 8. Approved changes to the work.

9. Details not originally included within the scope of the original contract documents.
  10. Mark and record field changes and detailed information contained in submittals and change orders.
  11. Provide schedules, lists, layout drawings, and wiring diagrams.
- F. Legibly mark each section of the specifications to record:
1. Manufacturer's trade name, catalog number, and supplier of each product and item of equipment installed,
  2. Changes made reflecting Approved changes to the Work.
- G. Legibly maintain shop drawings as record drawings. Annotate shop drawings to record changes made after Approval.

#### **1.05 Final Project Record Documents**

- A. At the time nearing Substantial Completion of the Work, obtain from the Engineer through the Owner's Representative the original AutoCAD or Electronically Derived Contract Documents. Unless otherwise notified, the Contractor shall reproduce the As-Built Contract Documents, transferring all identified changes during the construction project into the Record Drawings.
- B. The As Built Documents shall be Approved by the Project Inspector that all data has been correctly incorporated to the truest extent feasible.
- C. Submit the complete set of As Built Project Documents to the Owner's Representative upon request for Substantial Completion.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

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**SECTION 02055  
DEMOLITION AND SITE PREPARATION**

**PART 1 - GENERAL**

**1.01 Summary**

A. Section Includes:

1. Demolition and site preparation includes all demolition, and clearing and grubbing work.

**1.02 References**

A. The following documents are a part of this section insofar as they are specified and modified herein. In case of conflict between the requirements of this Section, and the following documents, the requirements of this section shall prevail:

<b><u>Reference</u></b>	<b><u>Title</u></b>
California Department of Transportation (Caltrans)	Standard Specifications, Section 4 - Scope of Work
California Department of Transportation (Caltrans)	Standard Specifications, Section 4-1.13 - Cleanup
California Department of Transportation (Caltrans)	Standard Specifications, Section 15 - Existing Facilities
California Department of Transportation (Caltrans)	Standard Specifications, Section 17-2 - Clearing and Grubbing
ASME B31.8	Gas Transmission In Piping Systems
49 CFR 192	Transportation Of Natural And Other Gas By Pipeline: Minimum Federal Safety Standards
AGA XR0603	AGA Plastic Pipe Manual for Gas Service

**1.03 Definitions**

A. Demolition: consists of furnishing transportation, labor, materials, and equipment to:

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. Store and protect items intended for reuse.
4. Assume ownership of debris and unwanted materials; remove from the site and dispose of legally.
5. Remove unwanted fixed equipment, including without limitation unwanted lockers, shelving, hoods, equipment, machinery, and devices built into or attached to the building.
6. Remove all loose items including rubbish, debris, furniture, etc.

B. Clearing and Grubbing: consists of furnishing transportation, labor, materials, and equipment to:

1. Remove and dispose of all rubbish, debris, and other objectionable material from within the limits of the project as specified.

2. Strip the entire area within the limits of work of trees, shrubs, weeds, and other vegetative growth of any nature, and disposal of same.
3. Grub the entire area within the limits of work of all roots and vegetative material to the full depth of the root system, and disposal of same.
4. Removal of existing pavement markers, pavement markings, traffic lines, pavement legends and weeds (along cracks, joints, and gutter lip) where needed and/or damaged as a result of the work performed under this contract.
5. Provide dust alleviation and control during the course of the work.
6. Comply with any required abandonment of system facilities, including cutting, capping and slurry filling of abandoned pipelines.
7. Provision of all materials, equipment and apparatus not specifically mentioned herein or noted on the plans, but which are obviously necessary to complete the work specified.
8. Comply with any required salvage of existing facilities.

#### **1.04 System Description (Not Used)**

#### **1.05 Submittals (Not Used)**

#### **1.06 Quality Assurance**

- A. General: All work shall be performed in accordance with the local building codes, State Industrial Safety Orders and requirements of the Occupational Safety and Health Act requirements.
- B. Schedule: Demolition must be scheduled to allow all existing services and utilities to remain in continuous operation. No interruption in operation will be permitted without previous authorization from the Owner's Representative.
- C. Prior to excavation procedures, the Contractor shall perform an above grade survey of existing utilities and contact Underground Service Alert (USA) North 811 to perform a comprehensive evaluation of all known below grade utilities.
  1. Reference the USA California Excavation Manual for Best Practices and excavation law/guidelines.
- D. Protection
  1. Demolition shall be performed in such a manner as to not harm adjacent structures, equipment, existing landscaping or natural vegetation.
    - a. The Contractor shall assume full responsibility for such disturbance.
    - b. All costs of any such repair, rehabilitation, or modifications shall be solely borne by the Contractor.
  2. The Contractor shall provide such protection as may be required to transfer material to the ground.
    - a. Throwing, dropping, or permitting the free fall of material and debris from heights which would cause damage to other work, existing structures, or equipment; undue noise or nuisance; or excessive dust is prohibited.
- E. Noise and Dust Control
  1. Perform work in accordance with requirements in Division 1.
  2. Provide temporary partitions to control dust and noise and exclude unauthorized persons.

3. Perform work in a manner to cause least disturbance to improvements, City occupants, commuters, and local residents and least damage to work to remain.
4. Maintain adequate means of safe, clear egress for local occupants and commuters.
5. Employ all available techniques for construction noise abatement. Use remote, well-muffled air compressors and newest noise suppressed pneumatic and electric tools.

#### **1.07 Delivery, Storage, and Handling (Not Used)**

#### **1.08 Project/Site Conditions**

- A. The Contractor shall determine the actual condition of the site as it affects the work.

#### **1.09 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 Engineer.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.01 General**

- A. The Contractor shall adhere to all demolition and site preparation requirements set forth in the District Design and Construction Standards Manual.
- B. The Contractor shall notify the Owner's Representative when demolition of existing is completed and dispose of refuse materials in an appropriate manner.

#### **3.02 Performance**

##### **A. Demolition**

1. Removal of Construction in areas to receive New Work
  - a. In areas intended to receive new work and/or finishes, remove all unwanted non-structural partitions, furred walls, chases, suspended or furred ceilings, doors, windows, and finishes.
  - b. 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.
  - c. Contractor shall protect mechanical and electrical work that serves other areas. Relocate concealed mechanical and electrical work that is required to preserve service to other areas.
  - d. Remove structural work designated for removal. Take precautions not to damage structural work intended to remain. Where temporary shoring is needed, the Contractor shall submit a design prepared by an appropriately licensed engineer for review before proceeding.
  - e. If structural elements are encountered that were not shown, the Contractor shall protect them from damage and report their presence to the Engineer.

##### **2. 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 only with the approval of the Engineer.
3. 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.
4. Protection of Work to Remain
- a. Protect all work to remain. Repair damage with materials, workmanship, and finishes matching existing work when new.
5. 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 approval. 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 his own expense, any damaged electrical or signal wiring or conduits.
6. Remove Unwanted Fixed Equipment

- a. Remove unwanted fixed and built-in equipment, machinery, machinery bases, and similar items whether shown or not. Protruding bolts or attachment devices shall be cut to be flush with existing surfaces.
- b. If items are designated on the Drawings to be salvaged, remove them carefully without causing damage. Equipment used in chemical feed systems shall be cleaned and flushed with potable water prior to removal. Contractor to provide Owner with 14 days' notice to tag all items Owner wants to be salvaged. Deliver items to be turned over to the Owner at a storage location designated by the Owner.

#### 7. Hazardous Materials

- a. If hazardous materials are discovered, comply with paragraph 1.01 of this Section and all applicable laws.

#### 8. Removal and Disposal of Material

- a. Store debris in suitable covered containers or stockpiles located where directed by the Engineer and remove from site when full or complete. Burning on the site is not permitted.
- b. Removed material (other than material to be reused or salvaged) shall become the property of the Contractor who shall remove it from the site and dispose of it in a legal manner.

### B. Clearing and Grubbing

1. The site of all open-cut excavations and areas to be cleared as indicated on the Plans shall be cleared and grubbed prior to excavation.
  - a. Unless otherwise specified, the Contractor shall remove obstructions such as brush, trees, logs, roots, root balls, heavy sod, vegetation, rock, stones larger than 6 inches by any dimension, broken or old concrete and pavement, debris, and structures.
2. Clearing and grubbing in areas of structural improvement such as concrete structures shall be cleared and grubbed as above except that obstructions larger than 2 inches in any dimension shall be removed.
3. Clearing and grubbing shall be done in accordance with Caltrans Standard Specifications Section 16, as amended below:
  - a. Ground cover of every type, including trees, shrubs, weeds, and vegetation of any nature, shall be removed to the full depth of the root system
  - b. Weed removal shall be accomplished by method(s) that result in complete removal of the weed. Method used must be approved by the Engineer. Surface and crack cleaning shall be accomplished by sweeping, and not by air blowers.
  - c. Prior to any cutting or filling, the site shall be stripped to a sufficient depth to remove all vegetation and other deleterious materials. The minimum stripping depth shall be six inches (6"). The site shall be stripped to such greater depth, as the Engineer or the project geotechnical engineer may consider necessary to remove materials that, in their opinion, are unsatisfactory. The stripping material shall either be removed from the site or stockpiled for reuse later as topsoil, where approved by the Engineer. Use of stripped material as engineered fill is strictly prohibited.
  - d. Contractor shall trim overhanging limbs that may be in conflict with paving and other construction activities. Tree, roots, and bush pruning shall be performed by a certified arborist and in accordance with "Pruning Standards," published by the Western Chapter of the International Society of Arboriculture. The certified arborist shall be approved in advance by the Engineer, and all pruning shall be done as directed by and in the presence of the Engineer. Tree limbs damaged by Contractor activities shall be trimmed by certified arborist as described above.

- e. Where trees are removed, the soils loosened by the roots shall be over-excavated at least to the bottom of the disturbed zone and to the width of the equipment.
- f. Spoil resulting from clearing, grubbing, and stripping operations shall be removed from the entire limits of work and properly disposed of by the Contractor.
- g. Materials resulting from clearing, grubbing, and stripping operations shall become the property of the Contractor, to be properly removed from the work site and disposed of from the project site in a lawful manner, at no additional expense to the contract.

#### C. Equipment and Piping Removal

- 1. Include removal of existing 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.
- 2. If indicated on the plans or in these specifications, include the cost of removing and disposing of hazardous material including without limitation asbestos or asbestos-containing material, lead-containing paint, PCBs or other hazardous materials. If the presence of a hazardous material is suspected, notify the Engineer and have material tested. If material is identified as hazardous, retain qualified and licensed specialist to remove and dispose of it legally.
- 3. All equipment and piping to be removed shall be properly disconnected from structures, piping, electrical, and instrumentation systems.
- 4. The Contractor shall do all resurfacing and other work as necessary to comply with the above requirements.
- 5. If illegal electrical wiring is encountered such as "BX" or non-metallic sheathed cable, notify the Engineer.
- 6. Removal of any existing and operational culverts shall be restored in kind at the Contractor's expense unless proven that the culvert condition was previously compromised by age, corrosion or other cause unrelated to construction activities. The Owner's Representative or Inspector shall be present during excavation and trenching of all culvert crossings.

#### D. Abandonment of Natural Gas Distribution Pipelines

- 1. Perform abandonment of existing gas piping in accordance with ASME B31.8, the contract drawing details and the requirements of 49 CFR 192, Section 727. Purge natural gas piping so that there is no potential hazard. Provide locking devices for the shut-off valve located at the end of the service line supplying gas to a discontinued customer. Cut the pipe without damaging the pipe. Unless otherwise authorized, use an approved type of mechanical cutter. Use wheel cutters where practicable. Cut plastic pipe in accordance with AGA XR0603.

#### E. Pavement Removal

- 1. All pavements and concrete pads shall be saw-cut on a neat line at right angles to the curb or concrete face. Utilize existing control or expansion joints where possible.

#### F. Utility Interference

- 1. Where existing utilities interfere with the prosecution of the work, the Contractor shall relocate the utilities. The Contractor shall coordinate with the utility owner and their respective requirements for utility relocation.
- 2. Where utilities that are not shown pass through construction that must be removed and those utilities serve other areas notify the Engineer a minimum of 72 hours before disrupting service. If rerouting is required to maintain service, the Owner may issue a Change Order to accomplish the required work.

3. Utilities to be abandoned in place shall be filled with flowable grout and capped unless otherwise specified on the Plans.

### **3.03 Salvage**

- A. The Owner has the right to salvage any items identified within the project vicinity.
- B. The Contractor shall notify the Owner's Representative no less than five (5) days prior to any salvage or demolition work.
  1. The Owner's Representative will mark items to be salvaged.
  2. The Contractor shall be responsible for properly disconnecting, removal from their foundations, cleaning and storing salvaged items. Salvaged items shall be delivered by the Contractor to a storage location designated by the Owner.
  3. All drop offs must be coordinated with the Owner.

### **3.04 Removed Material and Debris**

- A. Where Contractor is directed on the Drawings to "Demolish" or "Remove" material or facilities it is understood that the material will be removed and disposed of offsite unless specifically stated otherwise or directed by the Owner's Representative.
- B. All removed material not designated for salvage and all debris shall become the property of the Contractor and shall be removed from the site.
- C. Materials and debris generated by demolition activities shall not be allowed to accumulate. Debris shall be removed **daily** and disposed of in a manner allowed by law.

### **3.05 Backfill**

- A. Holes or depressions in the ground remaining after demolition of structures, pipelines, or equipment shall be filled with compacted backfill materials as specified in Section 02200 - Earthwork.

### **3.06 Restoration**

- A. Restore adjacent structures and facilities damaged during demolition or other construction to original or better condition.

**\*\*END OF SECTION\*\***

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## **SECTION 02140 DEWATERING**

### **PART 1 - GENERAL**

#### **1.01 Summary**

- A. Scope: The work of this Section includes dewatering necessary to lower and control groundwater levels and hydrostatic pressures to permit excavation and construction to be performed properly under dry conditions.
- B. Contractors Responsibility: Dewatering operations shall be adequate to assure the integrity of the finished project.
1. The responsibility for conducting the dewatering operation in a manner that will protect adjacent structures and facilities rests solely with the Contractor.
  2. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.
  3. The Contractor shall secure all necessary permits to complete the requirements of this Section of the Specifications. This requires permits from the Water Board either:
    - a. State Water Resources Control Board Water Quality Order No.2003-0003-DWQ - Statewide General Waste Discharge Requirements (WDRs) for Discharges to Land with A Low Threat to Water Quality; or
    - b. California Regional Water Quality Control Board, Central Valley Region, Order R5-2013-0074, NPDES No.CAG995001, Waste Discharge Requirements for Dewatering and Other Low Threat Discharges to Surface Waters.
  4. Contractor shall be responsible for all costs associated with disposal of the water from dewatering operations.
  5. The Contractor may utilize existing facilities for disposal of dewatering water only if noted on the Drawings or after receipt of written authorization from the Owner's Representative.
    - a. It use of existing facilities is allowed, contractor must coordinate all dewatering activities with the Owner's Representative.
    - b. Dewatering activities shall not impact the operation and maintenance of the Owner's existing facilities or equipment.

#### **1.02 References**

- A. Hydrogeological Data: See project Geotechnical Engineering Study for CCWD Arnold WWTF Improvement Project – Concord Project No. 8513.

#### **1.03 Definitions (Not Used)**

#### **1.04 System Description (Not Used)**

#### **1.05 Submittals**

- A. The following shall be submitted in compliance with Section 01300 - Submittals:
1. Prior to commencement of excavation, submit a detailed plan and schedule for dewatering activities of excavations.
  2. Flow capacity, pump sizing, pipeline sizing, and discharge velocity calculations.

3. Filtration system calculations and expected water quality of discharge effluent.
4. Demonstration of proposed dewatering system and verification that adequate personnel, materials and equipment are readily available for all dewatering activities.
5. Copy of any permit or discharge requirements.
6. Compliance with the requirements of the Stormwater Pollution Prevention Plan (SWPPP).

### **1.06 Control and Observation**

- A. Adequate control shall be maintained by the Contractor to ensure that the stability of excavated and constructed slopes are not adversely affected by water, that erosion is controlled and that flooding of excavation or damage to structures do not occur.
- B. It shall be the sole responsibility of the Contractor to control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
- C. Where critical structures or facilities exist immediately adjacent to areas of proposed dewatering, reference elevations at adjacent reference points shall be established and observed at frequent intervals to detect localized settling or heaving.
- D. A daily report shall be maintained by the Contractor. The following shall be recorded:
  1. Elevation of ground water and piezometric water levels in observation wells (if any).
  2. Change in elevation of reference points established.

## **PART 2 - PRODUCTS**

### **2.01 Equipment**

- A. Dewatering system shall include well points, sump pumps, temporary perforated PVC pipelines for water disposal, rock or gravel placement, temporary power, filtration units, and other means including standby pumping equipment maintained on the job site continuously.
- B. Temporary containment devices/structures from dewatering activities.

## **PART 3 - EXECUTION**

### **3.01 General Requirements**

- A. An adequate dewatering system shall be maintained to lower and control the groundwater to permit excavation, construction of structures, placement of piping, and placement of fill materials to be performed under dry conditions.
- B. Sufficient dewatering equipment shall be installed to pre-drain the water-bearing strata below the bottom of foundations, drains, sewers, pipelines and other excavations.
- C. The Contractor shall maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.
- D. The hydrostatic head in water-bearing strata below foundations, drains, sewers, pipelines and other excavations shall be reduced to ensure that the water level and piezometric water levels are below the excavation surface at all times.
  1. The piezometric water level shall be maintained a minimum of 3-feet below the excavation surface all times.

- E. If permitted by the District, necessary water filtration units may be installed to the dewatering system that is designed to purify the water to the degree necessary prior to discharge into the storm water system. The Contractor shall coordinate with the District to determine the required level of filtration and allowable discharge system capacities.
- F. The dewatering system shall be placed into operation prior to excavation below ground water level to lower the ground water level and shall be operated continuously 24 hours a day, 7 days a week until drains, sewers, pipelines and structures have been constructed and leak tested and fill materials have been placed and dewatering is no longer required.
- G. The site shall be graded to facilitate drainage.
  - 1. Surface runoff shall be diverted from excavations.
  - 2. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity away from the excavation.
- H. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- I. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock at no additional cost to the Owner.
  - 1. If groundwater enters the trench faster than it can be removed by the dewatering system, the underlying compacted soil may become unstable while compacting successive soil lifts. If this occurs, the unstable soil may need to be removed and replaced with free draining open graded drain rock. Drain rock should meet or exceed the following gradation specifications:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/4-inch	100
1/2-inch	95-100
3/8-inch	70-100
No. 4	0-55
No. 8	0-10
No. 200	0-3

- 2. Other approved backfill materials can again be used after placing the drain rock to an elevation that is higher than the groundwater.
- J. Flotation shall be prevented by the Contractor by maintaining a positive and continuous removal of water.
- K. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- L. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sand packed and/or other means shall be used to prevent pumping of fine sands or silts from the subsurface.
  - 1. A continual check shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.
- M. Water and debris shall be disposed of in a suitable manner in compliance with local and State regulations and without damage to adjacent property.

1. No water shall be drained into the installed or under construction facilities.
  2. Water shall be filtered to remove sand and fine-sized soil particles and further treated if required by regulatory agencies before disposal into any drainage system.
  3. Necessary permits for disposal of water, if applicable, shall be obtained by the Contractor from the appropriate regulatory agencies.
- N. The release of groundwater to its original level shall be performed in such manner to prevent disturbance of natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.
- O. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the Work and all costs thereof shall be included in the various contract prices in the Bid Forms, unless a separate bid item has been established for dewatering.
- P. The Contractor shall comply with all discharge permit and approved SWPPP requirements.

**\*\*END OF SECTION\*\***

# SECTION 02200 EARTHWORK

## PART 1 - GENERAL

### 1.01 Summary

- A. This section specifies all operations necessary to the excavation, loosening, filling, grading, hauling, compacting, removal, and control of earth, rock or other unspecified material for the construction of project facilities. This section also includes the quality assurance and placement requirements for all related backfill materials and their respective standards.
- B. Earthwork shall also include the following operations:
1. Backfill material and placement for site grading, structures, and piping.
  2. Compaction under and around structures.
  3. Pavement subgrade preparation.

### 1.02 References

- A. The following documents are a part of this section insofar as they are specified and modified herein. In case of conflict between the requirements of this Section, and the following documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
California Test Method 217	Method of Test for Sand Equivalent
ASTM C136	Method of Test for Sieve or Screen Analysis of Fine and Coarse Aggregates
ASTM D420	Standard Recommended Practice for Investigating and Sampling Soil and Rock for Construction Purposes
ASTM D1556	Method of Test for Density of Soil in Place by the Sand-Cone Method
ASTM D1557	Method of Test for Moisture-Density Relations of Soils, Using 10 lb. (4.5 kg) Hammer and 18 in. (457 mm) Drop
ASTM D2049	Standard Test Method for Relative Density of Cohesionless Soils
ASTM D2922	Standard Test Method for Density of Soil and Soil-Aggregate In Place by Nuclear Methods (Shallow Depth)
ASTM D2419	Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D3017	Method of Test for Moisture Content of Soil and Soil Aggregates in Place by Nuclear Methods (Shallow Depth)
ASTM D4318	Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4832	Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
ASTM D6023	Standard Test Method for Density, Yield, Cement Content, and Air Content of Controlled Low Strength Material (CLSM)

## **Reference**

## **Title**

Caltrans

2018 Standard Specifications

- B. The Contractor shall also utilize CCWD Standard Construction Specifications for construction requirements not listed herein.

### **1.03 Definitions**

- A. Compaction: The degree of compaction is specified as percent of relative compaction. The relative compactions refer to the maximum relative densities of dry soil obtainable at optimum moisture content.
- B. Excavation Slope: Excavation slope shall be defined as an inclined surface formed by removing material from below existing grade.
- C. Embankment Slope: Embankment slope shall be defined as an inclined surface formed by placement of material above existing grade.

### **1.04 System Description**

- A. Soils Report

1. See project geotechnical report:

Geotechnical Design Report: Geotechnical Engineering Study CCWD Arnold WWTF Improvement Project. Condor Earth, Sacramento, CA.

### **1.05 Performance Requirements**

1. Where mud or other soft or unstable material is encountered, remove such material, and refill space with stabilization material approved for use by the Engineer.
2. The Contractor shall obtain acceptable import material from other sources if surplus or borrow materials obtained within project easements do not conform to specified requirements or are not sufficient in quantity.
3. No extra compensation will be made for hauling or fill materials nor for water required for sufficient compaction.

### **1.06 Submittals**

- A. Submit current technical data for each type of material specified to prove compliance with the specifications in accordance with the requirements of Specification Section 01300 - Submittals.
- B. Contractor shall submit an excavation and backfill plan detailing hauling truck staging and routes, expected traffic impacts, proposed equipment and machinery, anticipated construction durations per section, temporary excavation stockpiling areas, and backfilling process. Excavation and backfilling plan shall be separate but consistent with statements provided in the Contractor's shoring plan.
- C. Mix Designs for all fill materials indicating referenced testing standards, gradations, Atterberg limits, specific gravity, sand equivalent, R-value, durability, moisture content.
- D. Submit documentation related to Contractor's proposed testing laboratory, capabilities, and equipment.
- E. Submit certified test reports of all specified tests performed by the Contractor.

1. Test reports shall be signed and sealed by a registered Engineer who practices in the State of California.

### **1.07 Quality Assurance**

- A. All soils testing will be done by a testing laboratory of the District's choice and expense except as otherwise noted.
- B. The Owner's Representative will take samples and perform tests for compliance with the specifications including Atterberg limits, specific gravity, sand equivalent, R-value, durability, moisture content, gradation, compaction, and density tests during placement of backfill materials to check compliance with these specifications.
- C. The Contractor shall remove surface material at locations designated by the Owner's Representative and provide such assistance as necessary for sampling and testing.
- D. The Owner's Representative may direct the Contractor to construct inspection trenches in compacted or consolidated backfill to determine that the Contractor has complied with these specifications.
- E. The District will bear the costs for sampling and testing specified in this Paragraph. The Contractor shall pay costs associated with retesting due to the Contractor's failure to comply with the specifications.
- F. Sequencing and Scheduling
  1. If necessary, stockpile excavated material in order to utilize it in separate locations. The Contractor shall not stockpile excavation spoils in an active roadway at any time during the project.
  2. Perform excavation and backfilling in a manner that encourages drainage at all times.

## **PART 2 - PRODUCTS**

### **2.01 Fill Materials**

- A. Water for earthwork compaction and dust control shall be furnished by the Contractor. The cost of water facilities shall be borne by the Contractor.
- B. Unless noted herein, fill materials shall be utilized in accordance with requirements shown on the project drawings and detailed in the CCWD Standard Specifications for Construction of Water Mains. Minimum trenching dimensions and elevations are reflected in the contract documents.
- C. The Contractor shall not repurpose excavation spoils at any time during the utility trench backfilling process unless otherwise approved by the Engineer of record and designated as a select fill.
- D. Classification of Excavated Materials:
  1. Rock:
    - a. Earth encountered during the course of excavation which is sufficiently hard to cause refusal to equipment specified below shall be deemed inexcavatable and therefore classified as 'rock'. Earth deemed inexcavatable shall be removed by substantial means such as reciprocating hydraulic hammers and shall conform to this specification.
    - b. Refusal to be considered as the inability of the following equipment to excavate material as caused by the hardness of the earth: Rock bucket excavator equipped with rock teeth and single ripper tooth, with minimum operating weight of 105,200 lbs and using a single ripper tooth. Refusal shall be demonstrated to Engineer prior to earth being deemed

inexcavatable and therefore defined as rock subject to this rock clause and unit price compensation.

- c. All rock excavation shall be under one classification. This classification shall include solid ledge rock in its natural location that requires systematic quarrying or drilling, and also boulders that exceed 0.25 CY in volume.
- d. When rock is encountered, strip free of earth. After verification by a representative of the District and/or Engineer that the material encountered is rock (as defined above), employ an independent surveyor to determine rock quantities before removal operation begins. In computing the volumetric content of rock excavation for payment, the pay lines shall be taken as follows:
  - 1) For structures (including foundations, vaults, etc.): 24 Inches outside the exterior limits of foundations and from rock surface to 12 Inches below bottom of foundations or unless otherwise noted in the project Geotechnical Report.
  - 2) For piping and utilities: A width 24 Inches wider than the outside diameter of the pipe or conduit and from rock surface to 6 Inches below bottom exterior surface of the pipe or conduit.
  - 3) Rock removed for benching, sloping excavations and other activities that are subject to the Contractor's means and methods shall not be included in the pay quantity.
- e. Hydraulic Hammer: Hydraulic hammering or alternative means approved by the Engineer shall be employed where refusal has been demonstrated and normal excavation procedures are not feasible.
- f. Remove and handle excavated materials regardless of its type, character, composition, condition, or depth.
- g. Blasting shall only be allowed under specified circumstances and performed in a method that limits the amount of public impacts. All blasting activities shall be under the discretion of the Engineer, Owner, and District representatives. The contractor shall bear the responsibility for obtaining all required permits and notifications associated with any blasting activities.

#### E. Trenching for Utilities

- 1. All trenches shall have vertical sidewalls. Width of trench shall be as shown on the plans.
  - a. Where allowable trench widths are exceeded, redesign shall be performed at no extra cost to the District, using stronger pipe or special installation procedures.
  - b. Restore all surfaces damaged or cut during excavation to original condition.
- 2. Excavate trench straight and true to line and grade and to a depth below the bottom of the pipe sufficient to provide for pipe bedding material as required. Trenches over-excavated in depth shall be re-filled with suitable materials and compacted to 95 percent (95%) relative compaction.
- 3. The Contractor shall provide all labor, equipment and materials for dewatering trenches and excavations and subsequent control of ground water.

#### F. Trench Bedding and Initial Backfill for Utilities:

- 1. Trench Bedding and Initial Backfill shall be in accordance with the CCWD Standard Detail G-05 unless otherwise approved by the Engineer. The bedding and initial backfill section for utilities and pipelines shall be defined as the pipe zone as indicated on the plans and CCWD Detail G-05.

2. For all piping, trench bedding and initial backfill shall be 3/4" Class II aggregate base material in conformance with the Project specifications and Section 26 of the State Specifications.
3. Any trench soil or moisture condition that prevents the bedding and haunching material from forming a firm and stable base requires the use of granular fill material for bedding and haunching and foundation as approved by the Engineer. Granular fill material shall consist of 3/4-inch gravel or crushed rock of which 100% shall pass the 3/4" sieve and with no material passing the No. 4 sieve.

G. Imported Select Fill:

1. Imported Select Fill material shall be crushed rock. All applications of select fill materials shall be Approved and Inspected by the Engineer prior to installation.
2. General requirements for select fills are described as:
  - a. The material shall be free from peat, wood, roots, bark, debris, garbage, rubbish or other extraneous material.
  - b. 100% of material shall pass the 3/4-inch sieve.
  - c. Not more than 10% material shall pass the No. 8 sieve.
  - d. The material shall have a minimum sand equivalent of 50 per Test Method No. Calif. 217.
  - e. The amount of fines passing a No. 200 sieve shall not exceed 20 percent.

H. 3/4" Gravel:

1. 3/4" Gravel shall be clean crushed stone or gravel material. Contractor may propose one of the following:
  - a. Granular Fill in accordance with CCWD Standard Details G-06. Gradation shall be 3/4-inch minus with no material passing the No. 4 sieve.
  - b. Class 1, Type A Permeable Material in accordance with Caltrans Standard Specification Section 68-2.02F(2).

I. Rip Rap Protection:

1. Shall be No. 3 Backing placed per Method B placement per Caltrans Section 72-2:
2. Rock must have the values for the material properties shown as follows

<u>Property</u>	<u>California Test</u>	<u>Percent by Weight Passing</u>
Apparent specific gravity	206	2.5 minimum
Absorption	206	4.2% maximum
Durability index	229	52 minimum

3. Complies with the following rock gradation:

<u>U.S. Standard Sieve Size</u>	<u>Percentage larger than</u>
25 lb	0 - 5
5 lb	25 - 75
1 lb	90 - 100

4. The percentage of rock smaller than the smallest rock size must be determined on the basis of weight. For all other rock sizes with a class, the percentage must be determined on the basis

of the ratio of the number of individual rocks larger than the smallest size shown for that class compared to the total number of rocks.

5. This material shall be free of clay, dirt, organic matter and other deleterious materials.
6. Any unsuitable materials that must be removed shall be disposed of at no cost to the District. No additional payments will be made for materials that must be replaced.

J. Sand:

1. All sand utilized for the project shall conform to the following gradation:

<u>U.S. Standard Sieve Size</u>	<u>Percent by Weight Passing</u>
3/8 inch	100
No. 4	90 - 100
No. 50	0 - 100
No. 100	0 - 8
No. 200	0 - 4

K. Class 2 Aggregate Base:

1. Class 2 Aggregate Base shall be ¾-inch maximum size free from organic or other deleterious substances, in conformance with the CALTRANS Standard Specifications Section 26.

<u>U.S. Standard Sieve Size</u>	<u>Percent by Weight Passing</u>
1 inch	100
¾ inch	90 - 100
No. 4	35 - 60
No. 30	10 - 30
No. 200	2 - 9

<u>Test</u>	<u>Minimum Value</u>
Resistance (R Value)	78
Sand Equivalent	22
Durability Index	35

L. Controlled Low-Strength Material (CLSM)

1. Material for filling pipelines to be abandoned shall be controlled low-strength material (CLSM), where shown on the drawings.
2. Controlled density fill mix design shall be produced and delivered by a concrete manufacturing batch plant and submitted to the Engineer for Approval prior to application. Periodic compressive strength testing shall be conducted by a third party, materials testing and engineering firm licensed to conduct compressive strength testing and results shall be submitted to the Engineer for review.

3. Compressive strength requirements:
  - a. Mix designs shall generate a 150-300 psi 28-day compressive strength in accordance with ASTM D4832.
4. Mix design requirements:
  - a. Water-cement ratio shall not exceed 3.5.
  - b. Minimum cement content shall be 50 pounds per cubic yard.
  - c. Fly ash content shall not exceed 300 pounds per cubic yard.
  - d. Unit weight shall be between 100 and 130 pounds per cubic foot in the as-placed condition as determined by ASTM D6023.
  - e. Slump shall be between 6 and 8 inches when tested in accordance with ASTM C143.

#### M. Geotextiles

1. Filter Fabric
  - a. Where specified or shown on the Drawings, filter fabric for subsurface drainage or gradation separation shall be a Class "A" non-woven polypropylene geotextile fabric and per Caltrans Section 96-1.02B.
2. Geotextile Reinforcement
  - a. Where specified or shown on the Drawings, fabric for soil stabilization or reinforcement shall be woven geotextiles, Mirafi Geolon HP370, or equal.
3. Erosion Control Mat
  - a. Where specified or shown on the Drawings, erosion control mat shall be Contech CFB2 Temporary Degradable Erosion Blanket, or equal.
  - b. Anchor and install erosion control blanket per manufacturer's requirements.

### **PART 3 - EXECUTION**

#### **3.01 General**

##### A. Overexcavation

1. At the direction of the Owner's Representative: Where the undisturbed condition of natural soils is inadequate for support of planned construction, the Owner's Representative will direct the Contractor to overexcavate to adequate supporting soils. The excavated space shall be backfilled and compacted to the specified elevation with 3/4-inch Class II or 3/4-inch crushed rock. Filter fabric shall be provided around all 3/4-inch crushed rock.
2. Due to Contractor's Operations: Should the excavation be carried below the lines and grades specified on the drawings or should the bottom of the excavation be disturbed because of the Contractor's operations and require overexcavation and backfill, the Contractor shall backfill such excavated space with a compacted material in accordance with fill requirements of this Section. Backfill and compaction shall be at Contractor's expense.
3. As an alternative to overexcavation, the Owner's Representative may direct the Contractor to reinforce the soil with woven geotextiles equivalent to Mirafi Geolon HP370.

##### B. Removal of Obstructions

1. The Contractor shall remove all brush, trees, logs, stumps, roots, heavy sods, heavy growth of grass, all decayed vegetative matter, fences, and all structures where the proper construction

and completion of the Work require their removal. The Contractor shall also remove all rocks, stones, broken concrete and pavement, debris and all obstructions of whatsoever kind or character, whether natural or artificial, encountered in the Work.

2. Material that is removed as hereinbefore specified, and is not to be incorporated in the Work, shall be properly disposed of off the site.

#### C. Surplus Material

1. Unless otherwise specified, surplus excavated material shall be disposed of in accordance with applicable ordinances and environmental requirements.
2. No excavated material shall be deposited on private property unless written permission from the property owner thereof is secured by the Contractor. Before the District will accept the work as being completed, the Contractor shall file a written release signed by all property owners with whom the Contractor has entered into agreements for disposal of excess excavated material absolving the District from any liability connected therewith.
3. The Contractor shall satisfy itself that there is sufficient material available for the completion of the required earthwork before disposing of any material inside or outside the site. The Contractor shall replace shortage of material, caused by premature disposal of any material by the Contractor.
4. Material shall not be stockpiled to a depth greater than 5 feet above finished grade within 25 feet of any excavation or structure except for those areas designated to be preconsolidated. For these areas, the depth of stockpiled material shall be as specified. The Contractor shall maintain stability of the soil adjacent to any excavation.

#### D. Borrow Material

1. If the quantity of acceptable material from excavation is not sufficient to construct the embankments required by the work, the quantity of material needed to complete the embankments shall consist of imported borrow conforming to specified requirements.

#### E. Hauling

1. When hauling is done over highways and/or private streets, the loads shall be trimmed and the vehicle shelf areas shall be cleaned after each loading. The loads shall be watered after trimming to eliminate dust.

#### F. Haul Roads

1. If required, Contractor shall construct haul roads required to transport materials on the Work site. Alignment of haul roads shall be selected to avoid interference with concurrent construction operations and facility operations. Haul roads shall be removed after completion of embankment construction.

#### G. Finish Grading

1. Finish surfaces shall be smooth, compacted and free from irregularities. The degree of finish shall be that normally obtainable with a blade-grader.
2. Finished grade will be as specified by the contours, plus or minus 0.10 foot, except where a local change in elevation is required to match sidewalks, curbs, manholes and catch basins, or to ensure proper drainage. Allowance for topsoil and grass cover, and subbase and pavement thickness shall be made so that the specified thickness of topsoil can be applied to attain the finished grade.
3. When the Work is at an intermediate stage of completion, the lines and grades shall be as specified plus or minus 0.5 foot to provide adequate drainage.

4. If the soil is to be cultivated or straw is to be incorporated into the surface, rocks larger than 2-1/2 inches in maximum dimension, roots and other debris on the surface of the slope shall be removed and disposed of prior to cultivation or placement of straw.

#### H. Control of Erosion

1. The Contractor shall maintain earthwork surface true and smooth and protected from erosion. Where erosion occurs, the Contractor shall provide fill or shall excavate as necessary to return earthwork surfaces to the grade and finish specified.

### 3.02 Earthwork for Structures

A. Earthwork for structures shall be in conformance with specification requirements stated herein, and per the CCWD Standard Drawings.

#### B. Structure Excavation

1. The bottom shall not be more than 0.15 foot above or below the lines and grades specified on the contract drawings. If the elevation or structure excavation is not specified, the excavation shall be not more than 0.15 foot above or below the elevation specified for fill material below the structure. Slopes shall vary no more than 0.5 foot from specified grade unless the excavation is in rock where the maximum variation shall be 2 feet.
2. Unless otherwise specified, excavations shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services, and for inspection, except where concrete is specified to be placed directly against excavated surfaces.

#### C. Foundation Treatment

1. The foundation of the new structures shall be excavated, backfilled and compacted as specified herein, on the contract drawings or as provided in the CCWD Standard Construction Specifications the Contractor shall make the necessary provisions to protect the foundations of existing structures adjacent to the new structures against disturbance during the new foundation installation activities.
2. At the completion of the excavation, the Owner's Representative shall inspect the bottom of the excavation. No further earthwork shall be performed prior to this inspection. Where unsuitable material is found, the Contractor shall overexcavate as directed by the Owner's Representative.
3. Upon the Owner's Representative's approval, the bottom of the excavation shall be scarified to a depth of 8 inches, then moisture conditioned to within two percentage points of optimum moisture content, and then shall be re-compacted to a minimum of 90 percent of maximum relative compaction.

#### D. Structure Fill and Backfill

1. Structural Fill and Backfill shall conform to the requirements of this Section or as shown on the Drawings. In the case of a conflict the more restrictive requirement shall govern.
2. After completion of construction below the elevation of the final grade, and prior to backfilling, forms shall be removed and the excavation shall be cleaned of debris.
3. Structure backfill shall not be placed until the subgrade portions of the structure have been inspected. No backfill material shall be deposited against concrete structures until the concrete has developed a compressive strength of not less than the specified 28 day concrete strength is reached.
4. Structural Backfill material shall be placed in uniform layers with uncompacted thickness of not more than 8 inches and shall be brought up uniformly on all sides of the structure. Each layer of backfill shall be compacted to a relative compaction of not less than 90 percent. The top 12

inches shall be compacted to at least 95 percent relative compaction. Where the backfill is under roadway or traffic area, the material within 8 inches below the roadbase shall be compacted to a relative compaction of not less than 95 percent. Compaction by means of water jetting or water ponding shall not be permitted.

5. Unless otherwise specified, backfill around and above pipelines within the excavation line of any structure shall be the same as that specified for structures.
6. Controlled Density Fill may be used for structural backfill where Approved by the Engineer.

#### E. Drain Rock

1. Drain rock below and around structures shall be completely encased in filter fabric.
  - a. Seams shall be overlapped a minimum of 3 feet and fastened per manufacturer's recommendations.
  - b. Repair all tears and cuts in fabric prior to backfill.
  - c. Take precautions to not damage fabric during backfill.
2. Drain rock to be placed under structures shall be compacted with 2 to 4 passes of a vibrating compactor into an even surface to minimize migration of finer material that may be placed on top of the rocks.

### **3.03 Excavation and Backfill for Pipelines and Conduits**

#### A. Trench Excavation

1. General Requirements:
  - a. Unless otherwise specified or indicated, excavation for pipelines and conduits shall be open cut. Trenching machines may be used except where their use will result in damage to existing facilities.
  - b. Where, in the opinion of the Owner's Representative, the undisturbed condition of the natural soils below the excavation grades indicated or specified is inadequate for the support of the planned pipeline, the City's Representative will direct the Contractor to overexcavate to adequate supporting soils and backfill the excavated space to the proper elevation. The bottom of the trench excavation shall be firm and dry.
  - c. Unless otherwise shown, trenches shall be excavated at least 4 inches below the final elevation of the barrel of the pipe.
  - d. The trench may be excavated by machinery to the grade indicated on the Drawings provided that the soil material remaining in the bottom of the trench is no more than slightly disturbed.
  - e. Open Trench:
    - 1) Trench Excavation shall proceed in advance of pipe installation only so far as can be backfilled the same day.
    - 2) Trench Stability: (AWWA 605-05 4.1.1.3)
      - a) Where necessary to prevent caving, trench excavations in unstable soils shall be adequately supported with steel sheeting or trench boxes. Before sheeting is withdrawn, or trench boxes moved forward, they shall be raised, in place, just above the pipe crown to safely allow the constructor to completely fill any voids left in the pipe zone.

#### B. Trench Width

1. The width of trench shall be a minimum 12 inches, and a maximum of 24-inches, wider than the pipe outside diameter, with a minimum of 6 inches clear on each side as shown on CCWD Standard Detail G-05. The maximum width shall be inclusive of all sheeting, lagging and bracing.
2. Wherever the maximum allowable trench width is exceeded for any reason, the Contractor shall provide improved bedding and/or extra strength pipe, as directed by the Owner's Representative.
3. All pipelines shall have minimum of 6 inches bedding material below the barrel of the pipe. Bedding shall be placed and compacted as specified for initial trench backfill and shall be placed to provide uniform support for the pipe.
4. Where, in the opinion of the Owner's Representative, stabilization of the undisturbed foundation below the overexcavated depth as shown is required because of the soft, spongy or unstable condition, backfill selected by the Owner's Representative shall be placed in the trench bottom.

C. Grading of Pipe Trench Bedding:

1. Bedding grading material shall be as specified.
2. For all sewer and storm drain piping:
  - a. Place a minimum of 6 inches of Bedding material below bottom of pipe.
  - b. Place Bedding material at uniform density, and with specified compaction.
3. Bell or coupling holes:
  - a. Dig holes after trench bottom has been graded.
  - b. Provide holes of sufficient width to provide ample room for installation of piping.
  - c. Excavate holes only as necessary for making joints and to ensure that pipe rests upon prepared trench bottom and not supported by any portion of the joint.
4. Depressions for joints, other than bell-and-spigot:
  - a. Make in accordance with recommendations of joint manufacturer for particular joint used.

D. Initial Backfill & Bedding

1. After the pipe has been properly installed on the consolidated bedding and inspected, initial backfill shall be placed around the pipe to a depth over the pipe as shown in the Drawings. The backfill material shall be placed in horizontal layers and compacted by power-operated tampers, rollers, or vibratory equipment to the relative compaction in accordance with Fill Requirements. Jetting of bedding or initial backfill is not allowed.
2. After the pipe is laid, place bedding and backfill material in lifts:
  - a. First Lift: Place and compact the bedding material in a single lift, even with the spring line of the pipe. Compact to 95% of maximum density.
  - b. Second and Subsequent Lifts: Place and compact bedding material in lifts of approximately 8 inches in uncompacted depth and compact to 95 percent of maximum density.
  - c. Each layer shall be compacted to the specified relative compaction prior to placing subsequent layers. The thickness of the loose layer may be increased when in-place compaction tests satisfactory to the Owner's Representative show that the specified relative compaction can be obtained. No further backfilling will be permitted until the Owner's Representative has accepted the initial backfill.

E. Subsequent Backfill

1. Above the level of initial bedding and backfill, the trench shall be filled with material as specified unless otherwise indicated on the Drawings. The backfill material shall be placed in horizontal layers and shall have a moisture content such that the required degree of compaction may be obtained. Each layer shall be compacted by power-operated tampers, rollers or other suitable equipment to the relative compaction as indicated in same table. Each layer shall be compacted to the specified relative compaction prior to placing subsequent layers.
2. Under structures:
  - a. Backfill trench up to underside of structure with aggregate base course material compacted to 95 percent of maximum density.
3. Under roadways, paved areas or storage areas:
  - a. Backfill trench up to within 2 feet of finish grade as indicated on the Drawings with native material compacted to 90 percent of maximum density.
  - b. Then backfill from 2 feet below finish grade to underside of pavement as indicated on the Drawings with aggregate base course material compacted to 95 percent of maximum density.
  - c. In areas outside the improved section of roadways or in open country:
    - 1) Backfill to finish grade as indicated on the Drawings with native material compacted to 90 percent of maximum density.
4. Through earth slopes adjacent to, or supporting structures:
  - a. Backfill to finish grade with aggregate base course material or select material compacted to 95 percent of maximum density.
5. Under existing intersecting pipes or conduits larger than 3 inches in diameter:
  - a. Backfill from bottom of new pipe trench to spring line of intersecting pipe or conduit with aggregate base course material compacted to 90 percent of maximum density.
  - b. Extend aggregate base course material two feet on either side of intersecting pipe or conduit to ensure that material remains in place while other backfill is being placed.
  - c. Backfill remainder of trench as specified above.
6. Compaction:
  - a. In-place density of compacted trench backfill, and bedding determined in accordance with ASTM D 1556, or with ASTM D 2922 and ASTM D 3017.
  - b. Maximum density obtained in laboratory when tested in accordance with ASTM D 1557.
  - c. Consolidation:
    - 1) Do not use water-settling methods such as flooding, poling, or jetting.

### **3.04 Paving Subgrade Preparation**

- A. The prepared subgrade shall be scarified to a depth of at least 8 inches, moisture conditioned as necessary, and recompacted to at least 95 percent of the maximum relative compaction based on the ASTM D1557 test method.
- B. Any localized zones of soft or pumping soils observed within the excavation base should either be scarified and recompacted as discussed above or be overexcavated and replaced with suitable material.

- C. Aggregate base course shall be compacted to at least 95 percent of the maximum relative compaction based on the ASTM D1557 test method.

### **3.05 Site Fill**

- A. Unless otherwise specified general site fill material shall be Select Fill or Engineered Fill compacted to a relative compaction of at least 90 percent. If the existing slope in an area to be filled is steeper than 5:1, the Contractor shall bench the area prior to filling.

### **3.06 Field Quality Control**

A. Tests:

1. Confirmation tests:

a. Contractor's responsibilities:

- 1) Accomplish specified compaction of trench backfill.
- 2) Control operations by confirmation tests to verify and confirm that compaction work complies, and is complying at all times, with requirements specified in this Section concerning compaction, control, and testing.
- 3) Cost of confirmation tests: Paid for by the Contractor.
- 4) Qualifications of Contractor's testing laboratory: Acceptable to Engineer. Provide lab certification.
- 5) Copies of confirmation test reports: Submit promptly to the Engineer.

b. Frequency of confirmation testing:

1) Perform testing not less than as follows:

- a) For trenches: At each test location include tests for each type or class of backfill from bedding to finish grade.
- b) In open fields: 2 every 1,000 linear feet.
- c) Under pavement cuts or within 2 feet of pavement edges: 1 location every 400 linear feet.

2) Compliance tests:

- a) Frequency of testing: Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements previously specified.
- b) If compaction fails to meet specified requirements: Perform remedial work by one of the following methods:
  - (i) Remove and replace backfill at proper density.
  - (ii) Bring density up to specified level by other means acceptable to the Engineer.

3) Retesting:

- a) Costs of retesting: Contractor is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
- b) Contractor's confirmation tests during performance of remedial work:
  - (i) Performance: Perform tests in manner acceptable to the Engineer.
  - (ii) Frequency: Double amount specified for initial confirmation tests.

**\*\*END OF SECTION\*\***

**SECTION 02222**  
**EXCAVATING, BACKFILLING AND COMPACTING FOR UTILITIES**

**PART 1 - GENERAL**

**1.01 Summary**

- A. Description of requirements for materials, equipment and services necessary to complete trenching, excavation, backfilling and compaction as shown and specified for utilities and related structures and thrust blocks. Utility companies' requirements where applicable will take precedence over these specifications.
- B. Related Sections
  - 1. Section 02200: Earthwork
  - 2. Divisions 15 and 16: Installation of Utilities

**1.02 References**

- A. American Society for Testing and Materials (ASTM) D1557-91 "Moisture-Density Relations of soils Using 10 lb. (4.5 kg) Rammer and 18-inch (457 mm) Drop".

**1.03 Quality Assurance**

- A. Requirements of Regulatory Agencies
  - 1. Safety Regulations: Work shall comply with all Federal, state and municipal regulations regarding safety, including the requirements of the following:
    - a. William-Steiger Occupational Safety & Health Act of 1970.
    - b. All trenching work shall conform to Trench Construction Safety Orders of California State Industrial Accident Commission.
- B. Observations and Inspections: The Geotechnical Engineer will observe and respective utilities agencies' representative will inspect utilities trenching, excavation, backfilling and compaction as appropriate. Contractor shall appropriately schedule all inspections prior to commencing trenching and backfilling operations. All installations are subject to satisfactory inspection by appropriate agency.
- C. Testing: Refer to Section 01660
  - 1. Backfill material compaction and other tests will be performed as deemed necessary by Geotechnical Engineer and utilities agencies' representative.

**PART 2 - PRODUCTS**

**2.01 Materials**

- A. Generally:
  - 1. Bedding, initial backfill and subsequent backfill to be Class 2 A.B. in all cases, except:
    - a. For utilities owned by utility companies (e.g. PG&E), bedding and backfill material and procedures shall conform to those the utility's specifications and requirements.
- B. Pipe bedding and initial backfill shall be well-graded granular material, less than  $\frac{3}{4}$  inch in greatest dimension, clean and free of clay, silt or organic matter, such that not more than five percent (5%) shall pass a No. 200 sieve, and judged suitable by Geotechnical Engineer.

1. Pipe bedding for PVC pipe shall be clean sand.
  2. Pipe bedding and backfill material used in trenches containing utilities owned by utility companies shall meet all requirements of that utility company.
- C. Trench Backfill material for backfilling trenches above the pipe bedding and initial backfill material shall be well-graded on-site native fill or import granular material, less than  $\frac{3}{4}$  inch in greatest dimension, clean and free of clay, silt or organic matter, such that not more than five percent (5%) shall pass a No. 200 sieve, and judged suitable by Geotechnical Engineer.
1. Initial backfill for PVC pipe shall be clean sand up to 12-inches over the top of pipe.
- D. Trenching "capping" material for use above trench backfill material shall be Class 2 A.B. in accordance with Caltrans standard.

## **PART 3 - EXECUTION**

### **3.01 Trenching**

- A. Make all trenches open vertical or sloped construction, as recommended by the manufacturer of the pipe, and with sufficient width to provide free working space at both sides of trench and around installed item as required for caulking, joining, backfilling, and compacting. Where no manufacturer's recommendations are available, trenches shall be not less than 12 inches nor more than 24 inches wider than pipe or conduit diameter.
1. Where recommended trench widths are exceeded redesign shall be performed at no extra cost to the Owner, using stronger pipe or special installation procedures.
  2. Restore all surfaces damaged or cut during excavation to original condition.
- B. Excavate trench straight and true to line and grade and to a depth below the bottom of the pipe sufficient to provide for pipe bedding material as required. Trenches over-excavated in depth shall be re-filled with suitable materials and compacted to 90 percent (90%) relative compaction.
- C. Excavations for utilities related structures and appurtenances, manholes, drop inlets or similar structures shall be sufficient to leave at least 12 inches clear between the outer structure surface and face of the excavations. When concrete is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation.
- D. Excavate additional 6 inches and provide 6-inch bed of sand to proper grade.
- E. Unsatisfactory material, as determined by the Project Manager, shall be removed and replaced with suitable material compacted to 90 percent (90%) relative compaction.
- F. Where depths are not shown, trench to sufficient depth to give minimum fill above top installed item measured from adjacent finished grade as follows:
1. Electrical conduit: 30 inches.
  2. Plumbing pipe: 36 inches.

### **3.02 Control of Ground Water**

- A. The Contractor shall provide all labor, equipment and materials for dewatering trenches and excavations and subsequent control of ground water.

### **3.03 Bracing and Shoring**

- A. The Contractor shall furnish, place, and maintain such bracing and shoring as necessary for the safety of workers, protection of adjacent facilities and utilities, and proper installation of pipe, in conformance with legal requirements.

### **3.04 Pipe Bedding Placement**

- A. A six-inch layer of pipe bedding material compacted to 90 percent (90%) relative compaction (per ASTM D1557) shall be placed and accurately shaped as required for the indicated pipe elevations and grades.

### **3.05 Backfilling**

- A. Initial Backfill Placement: Initial backfill material shall be placed and compacted to 90 percent (90%) relative compaction (per ASTM D1557) on both sides of the pipe simultaneously to avoid displacement of the pipe, six inches (6") above pipe.
- B. Trench Backfill Placement: Subsequent trench backfill material shall be placed in layers not exceeding six inches thick, and compacted to 90 percent (90%) relative compaction (per ASTM D1557) up to six inches from finish surface or subgrade.
- C. Trench "Capping" Material: The trench shall be "capped" above the trench backfill with trench "capping" material compacted to 95 percent (95%) relative compaction (per ASTM D1557) to subgrade or finish surface.
- D. Backfill for utility related or similar structures shall be placed as specified above and in such a manner that the structure will not be damaged.
- E. Remove excess earth from site and properly dispose of same.

**\*\*END OF SECTION\*\***

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**SECTION 02312**  
**CONTROLLED LOW STRENGTH MATERIAL (CLSM)**

**PART 1 - GENERAL**

**1.01 Summary**

A. Section includes: Controlled low strength material (CLSM).

**1.02 References**

A. ASTM International (ASTM)

<u>Reference</u>	<u>Title</u>
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field.
ASTM C33	Standard Specification for Concrete Aggregates.
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
ASTM C143	Standard Test Method for Slump of Hydraulic Cement Concrete.
ASTM C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
ASTM C260	Standard Specification for Air-Entraining Admixtures for Concrete.
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.

**1.03 System Description**

A. Performance requirements:

1. Total calculated air content: Not be less than 8.0 percent nor greater than 12.0 percent.
2. Minimum unconfined compressive strength: Not less than 50 pounds per square inch measured at 28 days.
3. Maximum unconfined compressive strength: Not greater than 150 pounds per square inch measured at 28 days.
4. Wet density: No greater than 132 pounds per cubic foot.

**1.04 Submittals**

- A. Product data: Submit data completely describing products.
- B. Sieve analysis: Submit sieve analyses of fine and coarse aggregates being used in triplicate. Resubmit at any time there is a significant change in grading of materials.
- C. Mix: Submit full details, including mix design calculations for mix proposed for use.
- D. Trial batch test data:
1. Submit data for each test cylinder.

- 2. Submit data that identifies mix and slump for each test cylinder.
- E. Cement mill tests: Include alkali content, representative of each shipment of cement for verification of compliance with specified requirements.
- F. Pozzolan certificate of compliance: Identify source of pozzolan and certify compliance with requirements of ASTM C 618.

**PART 2 - PRODUCTS**

**2.01 Materials**

- A. Portland cement: Type II low alkali portland cement.
- B. Fly ash: Class F fly ash in accordance with ASTM C 618.
- C. Water: As specified in Section 03300.
- D. Admixture: Air entraining admixture in accordance with ASTM C 260.
- E. Fine aggregate: Concrete sand that does not need to be in accordance with ASTM C 33. No more than 12 percent of fine aggregate shall pass a No. 200 sieve, and no plastic fines shall be present.
- F. Coarse aggregate: Pea gravel no larger than 3/8 inch.

<b>Material</b>	<b>Weight</b>	<b>Specific Gravity</b>	<b>Absolute Volume (CF)</b>
Cement	40 pounds	3.15	0.20
Fly Ash	300 pounds	2.30	2.09
Water	283 pounds	1.00	4.54
Coarse Aggregate	1,465 pounds	2.68	8.76
Fine Aggregate	1,465 pounds	2.68	8.76
Admixture	4-6 ounces	-	2.70
Total	3,553 pounds	-	27.00

**2.02 Source Quality Control**

- A. Trial batch:
  - 1. After mix design has been accepted by Engineer, have trial batch of the accepted mix design prepared by testing laboratory acceptable to Engineer.
  - 2. Prepare trial batches using specified cementitious materials and aggregates proposed to be used for the Work.
  - 3. Prepare trial batch with sufficient quantity to determine slump, workability, consistency, and to provide sufficient test cylinders.
- B. Test cylinders:
  - 1. Prepare test cylinders in accordance with ASTM C 31 with the following exceptions:
    - a. Fill the concrete test cylinders to overflowing and tap sides lightly to settle the mix.
    - b. Do not rod the concrete mix.
    - c. Strike off the excess material.

2. Place test cylinders in a moist curing room. Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
  3. Do not remove the test cylinder from mold until the cylinder is to be capped and tested.
  4. The test cylinders may be capped with standard sulfur compound or neoprene pads:
    - a. Perform the capping carefully to prevent premature fractures.
    - b. Use neoprene pads a minimum of 1/2 inch thick, and 1/2 inch larger in diameter than the test cylinders.
    - c. Do not perform initial compression test until the cylinders reach a minimum age of 3 days.
- C. Compression test 8 test cylinders: Test 4 test cylinders at 3 days and 4 at 28 days in accordance with ASTM C 39 except as modified herein:
1. The compression strength of the 4 test cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.
- D. If the trial batch tests do not meet the Specifications for strength or density, revise and resubmit the mix design, and prepare additional trial batch and tests. Repeat until an acceptable trial batch is produced that meets the Specifications.
1. All the trial batches and acceptability of materials shall be paid by the Contractor.
  2. After acceptance, do not change the mix design without submitting a new mix design, trial batches, and test information.
- E. Determine slump in accordance with ASTM C 143 with the following exceptions:
1. Do not rod the concrete material.
  2. Place material in slump cone in one semi-continuous filling operation, slightly overfill, tap lightly, strike off, and then measure and record slump.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Prior to placement, soils located below controlled low strength material placement shall be scarified to a depth of 8 inches, uniform moisture conditioned to or above the optimum moisture content, and compacted to a minimum of 95 percent relative compaction in accordance with ASTM D 1557.
- B. Place controlled low strength material by any method which preserves the quality of the material in terms of compressive strength and density:
1. Limit lift heights of CLSM placed against structures and other facilities that could be damaged due to the pressure from the CLSM, to the lesser of 3 feet or the lift height indicated on the Drawings. Do not place another lift of CLSM until the last lift of CLSM has set and gained sufficient strength to prevent lateral load due to the weight of the next lift of CLSM.
  2. The basic requirement for placement equipment and placement methods is the maintenance of its fluid properties.
  3. Transport and place material so that it flows easily around, beneath, or through walls, pipes, conduits, or other structures.
  4. Use a slump of the placed material greater than 9 inches, and sufficient to allow the material to flow freely during placement:

- a. After trial batch testing and acceptance, maintain slump developed during testing during construction at all times within plus or minus 1 inch.
5. Use a slump, consistency, workability, flow characteristics, and pumpability (where required) such that when placed, the material is self-compacting, self-densifying, and has sufficient plasticity that compaction or mechanical vibration is not required.

### **3.02 Field Quality Control**

#### **A. General:**

1. Make provisions for and furnish all material for the test specimens, and provide manual assistance to assist the Engineer in preparing said specimens.
2. Be responsible for the care of and providing curing condition for the test specimens.

#### **B. Tests by Owner:**

1. During the progress of construction, the Owner will have tests made to determine whether the controlled low strength material, as being produced, complies with the requirements specified hereinbefore. Test cylinders will be made and delivered to the laboratory by the Engineer and the testing expense will be borne by the Owner.
2. Test cylinders:
  - a. Prepare test cylinders in accordance with ASTM C 31 with the following exceptions:
    - 1) Fill the concrete test cylinders to overflowing and tap sides lightly to settle the mix.
    - 2) Do not rod the concrete mix.
    - 3) Strike off the excess material.
  - b. Place the cylinders in a safe location away from the construction activities. Keep the cylinders moist by covering with wet burlap, or equivalent. Do not sprinkle water directly on the cylinders.
  - c. After 2 days, place the cylinders in a protective container for transport to the laboratory for testing. The concrete test cylinders are fragile and shall be handled carefully. The container may be a box with a Styrofoam or similar lining that will limit the jarring and bumping of the cylinders.
  - d. Place test cylinders in a moist curing room. Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
  - e. Do not remove the test cylinder from mold until the cylinder is to be capped and tested.
  - f. The test cylinders may be capped with standard sulfur compound or neoprene pads:
    - 1) Perform the capping carefully to prevent premature fractures.
    - 2) Use neoprene pads a minimum of 1/2 inch thick, and 1/2 inch larger in diameter than the test cylinders.
    - 3) Do not perform initial compression test until the cylinders reach a minimum age of 3 days.
3. Not less than 3 cylinder specimens will be tested for each 150 cubic yards of controlled low strength material and not less than 3 specimens for each half day's placement:
  - a. Test 1 cylinder at 3 days and 2 at 28 days in accordance with ASTM C 39 except as modified herein.

- b. The compression strength of the cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.
  - 4. The Owner will test the air content of the controlled low strength material. Test will be made immediately after discharge from the mixer in accordance with ASTM C 231.
- C. Tests by Contractor:
- 1. Test the slump of controlled low strength material using a slump cone in accordance with ASTM C 143 with the following exceptions:
    - a. Do not rod the concrete material.
    - b. Place material in slump cone in one semi-continuous filling operation, slightly overfill, tap lightly, strike off, and then measure and record slump.
  - 2. Test the slump at the beginning of each placement, as often as necessary to keep the slump within the specified range, and when requested to do so by the Engineer.

**\*\*END OF SECTION\*\***

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**SECTION 02350  
SHEETING, SHORING, AND BRACING**

**PART 1 - GENERAL**

**1.01 Summary**

A. Section Includes

1. Specifications for sheeting, shoring, bracing, or other excavation supports.

B. Related Sections

1. Section 02200 – Earthwork.

**1.02 References**

- A. This section references the following documents. They are part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the most stringent requirement shall prevail.

<u>Reference</u>	<u>Title</u>
ASCE	Guidelines of Engineering Practice and Tied Back Excavations
Caltrans	Caltrans California Trenching and Shoring Manual
OSHA	Occupation Safety and Health Act, US Department of Health
CAL OSHA	State of California Construction Safety Orders – California State Labor Code
CCR	California Code of Regulations – Title 8
LAB	California Labor Code – Section 6705 to 6707

**1.03 Definitions**

- A. Shoring: A temporary structural system designed to support vertical faces, or nearly vertical faces, of soil or rock for purposes of excavation. Shoring includes cantilevered sheet piling, internally braced sheet piling, slurry walls, soldier piles and lagging, trench plates and vertical shoring, slide rail, and other similar shoring systems. Sloping (Benching) of the soil is not considered shoring as described herein however, sloping (benching) is considered an appropriate means of constructing a safe trench and may be considered for the use of project excavation.
- B. Shielding: A temporary structural system designed to protect workers from trench failure. A shield is not considered to be a temporary structural system designed to support vertical trench faces, or nearly vertical faces, of soil or rock for purposes of excavation and maintain trench wall consolidation. A shield may be used in conjunction with an active shoring system but shall not be substituted as an or-equal.

**1.04 Quality Assurance**

A. Design Requirements

1. Protection and Trench safety
  - a. The minimum required protection will be that described in the Cal/OSHA Construction Safety Orders of the Division of Industrial Safety.

- b. Pursuant to Section 6705 of the State Labor Code, all open excavations 5 feet or greater in depth shall be constructed with bracing, sheeting, shoring, or other equivalent method designed for the protection of life and limb.
  - c. The trench excavation and support system shall comply in all respects with the requirements of Article 6, of the Construction Safety Orders of the Division of Industrial Safety.
  - d. Perform design in accordance with soil characteristics and design recommendations contained in a written geotechnical report issued and signed by a California licensed geotechnical engineer.
  - e. The Contractor's attention is directed to the provisions of Article 6 of the California Construction Safety Orders for alternative shoring and sloping system. It shall be the Contractor's responsibility to provide the additional strength required to support the sides of the excavation against loads which may exceed those employed to derive the criteria set forth in the Industrial Safety Orders.
  - f. It shall be understood that the above stipulated requirements are to be considered to be the minimum to be provided.
  - g. The Contractor shall submit to the Owner's Representative a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation of such trench or trenches.
    - 1) If such plan varies from the shoring system standards, the plan shall be prepared and stamped by a California registered Civil Engineer.
    - 2) The Contractor shall adhere to the engineered trench shoring and backfill sequencing as designed by the shoring system design engineer. The Contractor's installation sequence is subject to the review and approval of the project Inspector.
  - h. The Contractor shall be solely responsible for any and all liabilities which may arise from the Contractor's failure to provide adequate shoring, bracing or sheeting as necessary to support the excavation under any or all of the conditions of loading which may exist, or which may arise during the construction of the project.
2. Excavation for structures
- a. All excavations shall be properly shored, sheeted and braced or cut back to the proper slope to furnish safe working conditions, to prevent shifting of material, to prevent damage to structures or other work, and to avoid delay to the Work, all in accordance with applicable safety and health regulations.
  - b. Before starting excavation for structures, the Contractor shall submit, for record purposes, complete design calculations and working drawings of proposed sheeting and bracing arrangements which have been prepared, signed and sealed by a California registered Civil Engineer.
  - c. Bracing shall be arranged so as not to place any strain on portions of completed work until the general construction has proceeded far enough to provide ample strength.
  - d. If the Owner's Representative is of the opinion that, at any point, the sheeting or supports are inadequate or unsuited for the purpose, the Owner's Representative may order the Contractor to resubmit design calculations and working drawings for that point, taking into consideration the observed field conditions.
  - e. If the new calculations show the need for additional sheeting and bracing, the Contractor shall immediately install it.
  - f. The sole responsibility for the design, methods of installation, and adequacy of the sheeting and supports shall be and shall remain that of the Contractor.

- g. The working drawings for shoring, sheeting and bracing will not be checked by the Owner's Representative.

### 3. Excavation Cover

- a. Steel plating shall be required for all excavations left open for less than three (3) weeks.
  - 1) Steel plates utilized for this purpose shall be nonskid finishes.
  - 2) If excavations are to be left open for 5 days or less, steel plates may be placed over the excavation. In existing AC pavement, the Contractor shall place cold mix Asphalt "Cutback" around the perimeter of the plates for a smooth transition.
  - 3) If excavations are to be left open for longer than 5 days, the Contractor shall saw cut/grind a key into the edges of pavement around the perimeter of the excavation to support the steel plates. These keys shall be cut/ground to a depth equal to the thickness of the plates used to span the excavation.
- b. If excavations are left open for more than three (3) weeks, the Contractor shall backfill the excavation with temporary backfill, in lieu of placing steel plates.
  - 1) Temporary backfill shall be placed and tamped to provide structural support under temporary paving adequate for traffic allowed on the roadway where applied with no perceptible deflection/settlement and no excessive loading on the utility line.
  - 2) The Contractor shall monitor stability of temporary backfill and pavement, and repair any depressions or indications of utility line impacts as soon as possible, scheduling with Engineer.

### B. Submittals

- 1. Excavation plan.
- 2. Sheeting, Shoring and Bracing Plan.
- 3. Trench Support Drawings:
  - a. In accordance with the requirements of Section 6705 of the Labor Code of the State of California, the Contractor shall submit detailed drawings to the Owner's Representative before excavation, showing the design of shoring, bracing, sloping or other provisions to be made for worker protection from the hazard of caving ground during the excavation of any trench or trenches 5 feet or more in depth.
  - b. The Contractor's proposed sheeting, shoring bracing plan shall also integrate the Contractor's proposed backfill methodology. The backfill methodology shall describe the Contractor's proposed backfilling sequence and shoring system extraction such that adjacent native soils are not compromised and newly installed backfill maintains completely compacted and no voids remain. No voids shall remain once the complete shoring system is removed.
  - c. The design shall be signed and stamped by a California registered Civil Engineer.
  - d. The drawings are for record purposes and will not be checked by the Owner's Representative.
- 4. Certification
  - a. The minimum required protection will be that described in the Construction Safety Orders of the Division of Industrial Safety.
  - b. If the Contractor presents excavation plans that vary from the shoring system standards established by the Construction Safety Orders, the Plans shall be prepared, stamped, and signed by a California registered Civil Engineer.

## **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

- A. Make all trenches open vertical or sloped construction with sufficient width to provide free working space at both sides of trench and around installed item as required, joining, backfilling, and compacting. Where no manufacturer's recommendations are available, trenches shall be not less than 12 inches nor more than 24 inches wider than pipe or conduit diameter.
  - 1. Where recommended trench widths are exceeded redesign shall be performed at no extra cost to the Owner, using stronger pipe or special installation procedures.
  - 2. Restore all surfaces damaged or cut during excavation to original condition.
- B. Excavate trench straight and true to line and grade and to a depth below the bottom of the pipe sufficient to provide for pipe bedding material as required.
- C. Excavations for utilities related structures and appurtenances, manholes, drop inlets or similar structures shall be sufficient to leave at least 24 inches clear between the outer structure surface and face of the excavations. When concrete is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation.
- D. Excavate additional 6 inches and provide 6 inches of pea gravel bedding.
- E. Unsatisfactory material, as determined by the Owner's Representative, shall be removed and replaced with suitable material compacted to 90 percent (90%) relative compaction.
- F. Where depths are not shown, trench to sufficient depth to give minimum fill above top installed item measured from adjacent finished grade as follows:
- G. The design, planning, installation and removal of all lagging, sheeting, shoring, sheet piling, and bracing shall be accomplished in such a manner as to maintain the undisturbed state of the soils adjacent to the trench and at and below the excavation bottom.
- H. The use of horizontal strutting below the barrel of a pipe or the use of a pipe as a support will not be permitted.
- I. Sheet piling and timbers in trench excavations shall be withdrawn in a manner so as to prevent subsequent settlement of the pipe or additional backfill loadings that might overload the pipe.

**\*\*END OF SECTION\*\***

**SECTION 02500  
ASPHALT CONCRETE PAVING**

**PART 1 - GENERAL**

**1.01 Summary**

A. This section provides specifications for asphalt concrete pavement and for asphalt concrete.

**1.02 References**

A. The Engineer has adopted the Caltrans Standard Specifications as the technical standard for work covered by this specification section where referenced. The adoption of this reference specification language is not intended to imply that the Tribe has adopted or is subject to any State requirements. In case of conflict between the requirements of this Section, and the following documents, the requirements of this section shall prevail.

**1.03 Submittals**

A. Submit in accordance with Section 01300 – Submittals copies of the report from the testing laboratory verifying that the aggregate material conforms to the specified gradations or characteristics.

**PART 2 - PRODUCTS**

**2.01 Asphalt Concrete**

A. All materials shall be in conformance with the following requirements of the most recent Caltrans Standard Specifications:

<b><u>Material</u></b>	<b><u>Requirements</u></b>
Crushed aggregate base	Section 26, Class II, 3/4" Max.
Asphalt concrete	Section 39, Type B, 1/2" Max.
Asphalt Binder	Section 92, PG 64-10
Tack coat	Section 39, Section 94, CSS1h
Slurry: Emulsion and aggregate	Section 37, QS1h emulsion and Type I aggregate
Pavement Reinforcing Fabric	Section 96

B. Asphalt concrete pavement shall consist of a subgrade as shown. The finish course shall consist of Type B, PG 64-10 asphalt concrete, of at least 3 inches thickness or as shown on the Drawings, whichever is thicker.

C. Asphalt concrete shall be provided with an emulsion-aggregate slurry seal applied on the completed finish course of the asphalt pavement.

D. A minimum of 6 inches of aggregate base or as shown on the Drawings, whichever is thicker, will be placed below all new asphalt paving.

## **2.02 Redwood Header (Not Used)**

## **2.03 Traffic and Parking Lot Striping and Marking**

- A. Provide white thermoplastic paint per Caltrans Standard Specification Section 84.

## **PART 3 - EXECUTION**

### **3.01 Asphalt Concrete Removal and Installation (If required and if indicated on the drawings)**

- A. All asphalt concrete pavement surface that has been removed, broken or damaged shall be re-paved. Removal of existing pavements shall be by saw cutting and in accordance with the project Contract Documents and Caltrans Standard Specification.
- B. All asphalt paving shall be cut to a neat, straight line and the exposed edge shall be tacked with emulsion prior to paving. The exposed base material shall be graded, recompact, and resealed prior to paving.
- C. Removed asphalt shall be disposed off the Work site. Removed asphalt shall not be used as backfill material on-site.
- D. Reclaimed asphalt material may be used on the Work site only with written approval from the Construction Manager. Reclaimed asphalt is asphalt that has been removed with a “grinding machine” and mixed with aggregate material to meet pre-approved requirements.
- E. Install asphalt concrete in accordance with Caltrans Standard Specification Section 39.
  - 1. Install asphalt concrete in two lifts for paving sections of 3-inches and greater.
- F. The asphalt concrete pavement shall be placed against a saw cut edge.

### **3.02 Compaction of Asphalt Concrete Paving**

- A. Compact until roller marks are eliminated and a density of 92% minimum to 98% maximum has been attained per ASTM D2041.
- B. Compacting equipment shall conform to the provisions of Caltrans Standard Specification Section 39.

### **3.03 Preparation of Subgrade (If required and if indicated on the drawings)**

- A. Subgrade shall be prepared in accordance with Section 02200 herein.
- B. Shape subgrade to line, grade, and cross section shown in the drawings.
- C. The finished subgrade shall be within a tolerance of 0.05 of a foot of the grade and cross section shown and shall be smooth and free from irregularities and at the specified relative compaction.

### **3.04 Placement of Aggregate Base Course (If required and if indicated on the drawings)**

- A. Place aggregate base course to a minimum thickness as required. Compact to 95% relative compaction and install in accordance with Caltrans Standard Specification Section 26.

### **3.05 Tack Coat Application**

- A. Apply tack coat on surfaces to receive finish pavement per Caltrans Standard Specifications 39. Apply tack to metal or concrete surfaces that will be in contact with the asphalt concrete paving.

### **3.06 Seal Coat Application (If required and if indicated on the drawings)**

- A. Apply slurry seal at end of project after all paving and major construction is complete.

- B. Apply slurry seal to new, overlay and existing asphalt as indicated on the Drawings.
- C. Apply slurry seal coat at the rate of 8 to 12 pounds of dry aggregate per square yard.
- D. Apply slurry seal per Caltrans Standard Specification Section 37.

### **3.07 Asphalt Concrete Overlay**

- A. Provide asphalt concrete overlay in areas indicated on the Drawings.
- B. Repair or replace existing asphalt concrete pavement surfaces damaged or removed by construction activities prior to overlay.
- C. Milling of the existing asphalt pavement is required to provide a smooth transition where overlay meets existing pavement surfaces and to maintain grades and surface drainage away from existing structural slabs and buildings.
- D. Contractor shall be responsible for raising all manholes, valve boxes or any at grade structure to remain to match new final grade of asphalt overlay.
- E. Install pavement reinforcing fabric on existing pavement to receive overlay. Installation of fabric, binder/tack coat and overlay shall be per Caltrans Standard Specification Section 39.
- F. Asphalt concrete overlay thickness shall be a minimum of 2 inches or as shown on the Drawings.

### **3.08 Surface Tolerance**

- A. Finished grade of overlay shall be 2" from existing ground and will not deviate more than 0.02 foot in elevation. Overlay shall retain drainage slopes of the existing surface.

### **3.09 Traffic and Parking Lot Striping and Marking Paint Application (if required and if indicated on the drawings)**

- A. Apply in accordance with Caltrans Standard Specification Section 84.

**\*\*END OF SECTION\*\***

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## SECTION 02667 TESTING OF HYDRAULIC STRUCTURES

### PART 1 - GENERAL

#### 1.01 Summary

A. This section includes cleaning, flushing, and testing all hydraulic structures, including the conveyance and disposal of test water.

#### 1.02 References

A. The following documents are a part of this section insofar as they are specified and modified herein. In case of conflict between the requirements of this Section, and the following documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ACI 350.1	Tightness Testing of Environmental Engineer Structures

#### 1.03 Definitions

A. HST Testing Criteria

1. HST 025 allows up to 0.025 percent per day of total test water volume loss.
2. HST 050 allows up to 0.050 percent per day of total test water volume loss.

#### 1.04 Testing plan

A. A test schedule, including proposed plans for water conveyance, control and disposal, shall be submitted to the Owner's Representative for approval a minimum of 14 days prior to the test. The submittal shall include the methods to determine evaporation loss and the Contractor's plan for the release of water from structures after testing has been completed.

### PART 2 - PRODUCTS

#### 2.01 Materials Requirements

A. Temporary valves, bulkheads, or other water control equipment and materials required for the implementation of the testing plan shall be provided by the Contractor. No materials shall be used which would be injurious to the structure or its future function.

### PART 3 - EXECUTION

#### 3.01 General

- A. Except as otherwise indicated, potable water for testing will be furnished by the Contractor who shall also make necessary arrangements for conveying the water to the points of use.
- B. All hydraulic structures shall be tested before the structure's interior lining has been applied. The concrete structure shall be watertight without relying on the application of an interior lining. This means that all joint gaskets and waterstops shall be checked for proper operation.
- C. Release of water from structures, after testing has been completed, shall be as approved by the Owner's Representative.

### **3.02 Preliminary Cleaning and Flushing**

- A. Prior to testing, all hydraulic structures shall be cleaned by thoroughly hosing down all surfaces with a high pressure hose and nozzle of sufficient size to deliver a minimum flow of 50 gpm. All water, dirt, and foreign material accumulated in this cleaning operation shall be discharged from the structure or otherwise removed.

### **3.03 Testing of Hydraulic Structures**

- A. General: Testing shall be performed prior to backfilling the perimeter excavation, except where otherwise the testing is acceptable to the Owner's Representative.
- B. Testing of cast-in-place concrete structures shall not be performed sooner than 28 days after all portions of the entire structure, including all walls and associated roof or elevated slab systems have been poured and completed, but not before all components have reached design strength as demonstrated by cylinder test results. For precast concrete structures, testing may commence as soon as the structure has been completely assembled.
- C. The test shall consist of filling the structure with water to the maximum design water level and testing for visible leaks.
  - 1. Contractor shall coordinate with the Engineer to determine the maximum required testing water level. Except as noted on the drawings, the water level shall not be lower than the Influent gravity sewer elevation. The rate of filling shall not exceed 4 feet of depth per hour. All visible leakage shall be repaired via polyurethane injection or other system approved by the Engineer.
  - 2. During the test period, examine exposed portions of the structure, and mark visible leaks or damp spots. A damp spot is defined as an area which seeps sufficient moisture to dampen a paper towel when pressed against it. Repair visible leaks or damp spots after dewatering.
- D. Multi-celled containment structures: Where operational use conditions require that adjacent cells remain dry while cells are full of liquid, individual cells must be tested independently.
- E. Testing shall be performed prior to the application of any specified protective coating unless structure is lined with a factory installed T-Lock Liner. Liner seams shall be field welded and tested prior to hydraulic testing.
- F. Leakage test: After the structure has been filled, the water loss leakage test shall be performed as follows:
  - 1. The Contractor shall create a formal testing log with the following data:
    - a. Date and Time of the start testing,
    - b. Original reference height at start of test,
    - c. Wet well diameter,
    - d. Date and time of each incremental test measurement,
    - e. Water level at each incremental test measurement,
    - f. Information of tester for each incremental test measurement and signature,
    - g. Information on witnessing inspector for each incremental test measurement and signature.
    - h. Concluding test information, total change in water elevation, and total change in volume.
  - 2. Prior to filling with water, the interior and exterior of the concrete shall be visually inspected for defects.
  - 3. A measurement datum or reference point shall be established and agreed upon by the project Inspector. All measurements shall be made in the presence of the Inspector with no

exceptions. If the Inspector does not sign off on the testing measurements, then the Contractor shall reperform the test at their own expense.

4. An initial water level reading shall be made three days after the structure has been filled. The water level shall be checked each day for Seven days following the initial reading. The structure shall be considered to have passed the test if water loss during the 7-day period, as computed from the two water level readings, does not exceed the maximum permissible amount and it passes the visible leak requirements above. For lined tanks, the HST-025 criteria applies.
5. Measurements shall be taken at least once per day. Testing records shall include both raw data, and data corrected for evaporation and temperature.
6. If intermediate readings or observed leakage indicate that the allowable leakage will be exceeded, the test may be terminated before the end of the 7-day period and appropriate action shall be taken to correct the problem before commencing a new 7-day test period.
7. Should the structure fail to pass the test, the test shall be repeated for up to 3 additional 7-day test periods.
8. If, at the end of 28 days, the structure still fails to pass the leakage test, the Contractor shall empty the structure and shall examine the exterior and interior for evidence of any cracking or other conditions that might be responsible for the leakage.

#### G. Repairs

1. For Concrete water bearing structures:
  - a. All visible cracking larger than 1 mm (0.04 inch) shall be repaired, regardless of whether or not the tank passes the leak test.
  - b. Any cracks shall be repaired and sealed with an injectable epoxy or water activated polyurethane resin sealant. Any evidence of leakage shall be repaired. Following these operations, the Contractor shall again test the hydraulic structure.
  - c. All costs associated with structural concrete crack repair shall be the responsibility of the Contractor.
  - d. Injectable Water Activated Polyurethane Resin Sealant Repair Method
    - 1) Remove surface coatings and expose crack. Make the surface flush using grinding wheel or wire brush.
    - 2) Drill angled holes to intercept the crack, on alternating sides of the crack.
    - 3) Using the water pump, pump clean water into holes and flush out drilling dust.
    - 4) Install injection ports into holes.
    - 5) Install zerk fitting onto lowest port of a vertical crack or very end of a horizontal crack.
    - 6) Pump water into port. Begin at 250 psi and increase as needed until clean water comes out of the crack or the next port. Dye can be added to better see the flow.
    - 7) If water does not come out from the crack or the next port, the injection port may not be intersecting the crack. Redrill the injection hole on the opposite side of the crack and do not intersect the first injection hole.
    - 8) Repeat step f and g, port-by-port.
    - 9) Using resin pump, pump resin into port. Pumping may take several minutes. Increase pressure 100 psi at a time, as needed. Pumping may require 2500 psi. Be cautious of po

rt blowout. Observe resin coming out of crack. It may help to remove the zerk fittings on other ports to see resin coming out.

- 10) If resin flows freely from crack, stop injection and wait a few minutes. Resume injection. Repeat steps i and j, port-by-port.
  - 11) Allow resin to cure.
  - 12) Remove ports from concrete.
  - 13) Remove excess resin by scraping/grinding.
  - 14) Patch port holes with hydraulic cement or approved material.
- e. Injectable Epoxy Sealant Repair Method

1) Repair Preparation Procedures:

- a) Clean the surface area ½ in wide on each side of the crack with wire brushing or high-pressure water prior to installing injection ports and cap seal to ensure the cap seal will bond to the concrete.
- b) Drill and install injection ports directly on top of the crack and perpendicular to the concrete surface.
- c) If rebar is encountered, adjust port spacing to miss rebar, but not to exceed 18 inches on center.
- d) Drilling while the structure is full of water can be a benefit in verifying that the hole has intercepted the crack by observing leakage from the hole.
- e) Clean water will be used at a minimum 250 psi to clean contaminants out of the crack.
- f) After all cracks have been identified and chased out with a series of holes, drain the structure and move to sealing the surface cracks
- g) Install seal cap 1" wide over the length of the crack after installation of the ports and flushing the crack. Seal the exterior surface of the cracks with Sikadur 31 Hi-Mod Gel and allow 24 hours for the surface patch to cure then move to injection.

2) Injection and Crack Repair Procedures:

- a) Confirm that the cap seal has properly cured prior to injection.
- b) Clean the holes with compressed air and install an Injection Packer in the lowest hole for each identified crack. Insert injection packers into subsequent holes and install the remaining injection packers without a Zerk fitting to observe movement of epoxy up or along the crack.
- c) Mix Sikadur 35 Hi-Mod LV per the manufacturer's recommendation and prime the positive displacement injection pump (Titan model 640 or equal). For very tight or small cracks Sikadur 55 ULV may be utilized as Approved by the Engineer.
- d) Prime pump with epoxy and purge lines until the epoxy flows from the unit and dispose of a few additional ounces of product.
- e) Connect the pump to the first packer and inject epoxy at approximately 200 PSI, increasing the pressure slowly to approximately 1,000 PSI or until epoxy is observed flowing in the next port. Allow a few minutes for the epoxy to penetrate before moving to max pressure. Seal the second port and repeat the injection.
- f) Follow the injection procedure in subsequent ports until epoxy flows from the entire crack. If a port does not fill with or leak epoxy move to the next port and continue

(determine if the crack was filled and if in doubt add a new port on the opposite side of the failed port)

- g) If epoxy is observed flowing from a crack beyond the installed ports, additional ports and injection may be required. Chase a crack until no further leakage is observed.
- h) Repeat the injection procedure until all cracks are filled and inspect the interior surface to determine if additional injection is needed.
- i) Purge and dispose of any unused epoxy immediately upon completion or at the end of its pot life, and purge and wash the unit with the recommended solvent.

2. For Metal water bearing structures:

- a. Confirm the location of leakage.
- b. Drain the Structural Tanks free of water.
- c. Reweld all leaking seams in accordance with the requirements designated by the Structural Engineer.
- d. Retest.

H. Acceptance: The structure shall not be accepted as completed until the leakage test is passed and all visible leakage is repaired.

**\*\*END OF SECTION\*\***

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**SECTION 02834  
MODULAR CONCRETE RETAINING WALL**

**PART 1 - GENERAL**

**1.01 Description**

- A. Work shall consist of furnishing and construction of a Retaining Wall System in accordance with these specifications and in reasonably close conformity with the lines, grades, design, and dimensions shown on the plans.
- B. Work includes preparing foundation soil, furnishing and installing leveling pad, unit drainage fill and backfill to the lines and grades shown on the construction drawings.
- C. Work includes furnishing and installing geogrid soil reinforcement of the type, size, location, and lengths designated on the construction drawings.

**1.02 Related Sections**

- A. Section 02200 - Earthwork

**1.03 Reference Documents**

- A. American Society for Testing and Materials (ASTM)
  - 1. ASTM C140 Sampling and Testing Concrete Masonry Units
  - 2. ASTM C1372 Specification for Dry-Cast Segmental Retaining Wall Units
  - 3. ASTM D422 Particle-Size Analysis of Soils
  - 4. ASTM D698 Laboratory Compaction Characteristics of Soil -Standard Effort
  - 5. ASTM D1557 Laboratory Compaction Characteristics of Soil -Modified Effort
  - 6. ASTM D3034 Polyvinyl Chloride Pipe (PVC)
  - 7. ASTM D4318 Liquid Limit, Plastic Limit and Plasticity Index of Soils
  - 8. ASTM D4475 Horizontal Shear Strength of Pultruded Reinforced Plastic Rods
  - 9. ASTM D4476 Flexural Properties of Fiber Reinforced Pultruded Plastic Rods
  - 10. ASTM D4595 Tensile Properties of Geotextiles - Wide Width Strip
  - 11. ASTM D5262 Unconfined Tension Creep Behavior of Geosynthetics
  - 12. ASTM D5818 Evaluate Installation Damage of Geosynthetics
  - 13. ASTM D6637 Tensile Properties of Geogrids – Single or Multi-Rib
  - 14. ASTM D6638 Connection Strength - Reinforcement/Segmental Units
  - 15. ASTM D6706 Geosynthetic Pullout Resistance in Soil
  - 16. ASTM D6916 Shear Strength Between Segmental Concrete Units
- B. American Association of State Highway and Transportation Officials (AASHTO)
  - 1. AASHTO M 252 Corrugated Polyethylene Drainage Pipe

- C. Geosynthetic Research Institute (GRI)
  - 1. GRI-GG4 Determination of Long Term Design Strength of Geogrids
  - 2. GRI-GG5 Determination of Geogrid (soil) Pullout
- D. National Concrete Masonry Association (NCMA)
  - 1. NCMA SRWU-1 Test Method for Determining Connection Strength of SRW
  - 2. NCMA SRWU-2 Test Method for Determining Shear Strength of SRW

#### **1.04 Submittals/Certification**

- A. Contractor shall submit a Manufacturer's certification, prior to start of work, that the retaining wall system components meet the requirements of this specification and the structure design.
- B. Contractor shall submit construction drawings and design calculations for the retaining wall system prepared and stamped by a Professional Engineer registered in the state of the project. The engineering designs, techniques, and material evaluations shall be in accordance with the Manufacturer's Design Manual, NCMA Design Guidelines For Segmental Retaining Walls, or the AASHTO Standard Specifications for Highway Bridges (whichever is applicable to designer).
- C. Contractor shall submit a test report documenting strength of specific modular concrete unit and geogrid reinforcement connection. The maximum design tensile load of the geogrid shall be equal to the laboratory tested ultimate strength of geogrid / facing unit connection at a maximum normal force limited by the "Hinge Height" of the structure divided by a safety factor of 1.5. The connection strength evaluation shall be performed in accordance with ASTM D6638 (NCMA SRWU-1).

#### **1.05 Quality Assurance**

- A. Contractor shall submit certification, prior to start of work, that the retaining wall system (modular concrete units and specific geogrid):
  - 1. Has been successfully utilized on a minimum of five (5) similar projects, i.e., height, soil fill types, erection tolerances, etc.; and
  - 2. Has been successfully installed on a minimum of 1 million (1,000,000) square feet of retaining walls.
- B. Contractor shall submit a list of five (5) previously constructed projects of similar size and magnitude by the wall installer where the specific retaining wall system has been constructed successfully. Contact names and telephone numbers shall be listed for each project
- C. Contractor shall provide evidence that the design engineer has a minimum of five years of documental experience in the design for reinforced soil structures. The design engineer shall provide proof of current professional liability insurance with an aggregate coverage limit of not less than \$2,000,000.
- D. Owner shall/may provide soil testing and quality assurance inspection during earthwork and wall construction operations. Contractor shall provide any quality control testing or inspection not provided by the Owner. Owner's quality assurance program does not relieve the contractor of responsibility for quality control and wall performance.

## **1.06 Delivery, Storage and Handling**

- A. Contractor shall check all materials upon delivery to assure that the proper type, grade, color, and certification have been received.
- B. Contractor shall protect all materials from damage due to jobsite conditions and in accordance with manufacturer's recommendations. Damaged materials shall not be incorporated into the work.

## **PART 2 - PRODUCTS**

### **2.01 Definitions**

- A. Modular Unit - a concrete retaining wall element machine made from Portland cement, water, and aggregates.
- B. Structural Geogrid - a structural element formed by a regular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with surrounding soil, rock, or earth and function primarily as reinforcement.
- C. Unit Drainage Fill - drainage aggregate, which is placed within and immediately behind the modular concrete units.
- D. Reinforced Backfill - compacted soil, which is placed within the reinforced soil volume as outlined on the plans.

### **2.02 Manufacturer:**

- A. Retaining wall shall be Keystone Compac III or approved equal.

### **2.03 Modular Concrete Retaining Wall Units**

- A. Modular concrete units shall conform to the following architectural requirements:
  - 1. Face color - concrete gray, unless otherwise specified. The Owner may specify standard manufacturers' color.
  - 2. Face finish - sculptured rock face in angular tri-planer configuration. Other face finishes will not be allowed without written approval of Owner.
  - 3. Bond configuration - running with bonds nominally located at midpoint vertically adjacent units, in both straight and curved alignments.
  - 4. Exposed surfaces of units shall be free of chips, cracks or other imperfections when viewed from a distance of 10 feet under diffused lighting.
- B. Modular concrete materials shall conform to the requirements of ASTM C1372 - Standard Specifications for Segmental Retaining Wall Units.
- C. Modular concrete units shall conform to the following structural and geometric requirements measured in accordance with ASTM C140 Sampling and Testing Concrete Masonry Units:
  - 1. Compressive strength:  $\geq 3000$  psi (21 MPa);
  - 2. Absorption:  $\leq 8$  % (6% in northern states) for standard weight aggregates;
  - 3. Dimensional tolerances:  $\pm 1/8$ " (3 mm) from nominal unit dimensions not including rough split face,  $\pm 1/16$ " (1.5 mm) unit height - top and bottom planes;
  - 4. Unit size: 8" (203 mm) (H) x 18" (457 mm)(W) x 12" (304 mm)(D) minimum;

5. Unit weight: 75-lbs/unit (35 kg/unit) minimum for standard weight aggregates.
- D. Modular concrete units shall conform to the following performance testing:
1. Inter-unit shear strength in accordance with ASTM D6916 (NCMA SRWU-2): 600-plf (8 kN/m) minimum at 2-psi (13 kPa) normal pressure;
  2. Geogrid/unit peak connection strength in accordance with ASTM D6638 (NCMA SRWU-1): 500-plf (7 kN/m) minimum at 2-psi (13 kPa) normal force.
- E. Modular concrete units shall conform to the following constructability requirements:
1. Vertical setback =  $1/8" \pm$  (3 mm) per course (near vertical) or 1" (25 mm)+ per course per the design;
  2. Alignment and grid positioning mechanism - fiberglass pins, two per unit minimum;
  3. Maximum horizontal gap between erected units shall be  $\leq 1/2$  inch (13 mm).

#### 2.04 Shear Connectors

- A. Shear connectors shall be 1/2-inch (12 mm) diameter thermoset isophthalic polyester resin-pultruded fiberglass reinforcement rods or equivalent to provide connection between vertically and horizontally adjacent units with the following requirements:
1. Flexural Strength in accordance with ASTM D4476: 128,000 psi (882 MPa) minimum;
  2. Short Beam Shear in accordance with ASTM D4475: 6,400 psi (44 MPa) minimum.
- B. Shear connectors shall be capable of holding the geogrid in the proper design position during grid pre-tensioning and backfilling.

#### 2.05 Base Leveling Pad Material

- A. Material shall consist of a compacted crushed stone base or non-reinforced concrete as shown on the construction drawings.

#### 2.06 Unit Drainage Fill

- A. Unit drainage fill shall consist of clean 1" (25 mm) minus crushed stone or crushed gravel meeting the following gradation tested in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch (25 mm)	100
3/4-inch (19 mm)	75-100
No. 4	0 - 10
No. 50	0 - 5

- B. One cubic foot (0.028 m<sup>3</sup>), minimum, of drainage fill shall be used for each square foot (0.093 m<sup>2</sup>) of wall face. Drainage fill shall be placed within cores of, between, and behind units to meet this requirement.

C.

## 2.07 Reinforced Backfill

- A. Reinforced backfill shall be free of debris and meet the following gradation tested in accordance with ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
2-inch (50 mm)	100
3/4-inch (19 mm)	100-75
No. 40	0-60
No. 200	0-35

Plasticity Index (PI) <15 and Liquid Limit <40 per ASTM D-4318.

- B. The maximum aggregate size shall be limited to 3/4 inch (19 mm) unless field tests have been performed to evaluate potential strength reductions to the geogrid design due to damage during construction.
- C. Material can be site-excavated soils where the above requirements can be met. Unsuitable soils for backfill (high plastic clays or organic soils) shall not be used in the backfill or in the reinforced soil mass.
- D. Contractor shall submit reinforced fill sample and laboratory test results to the Architect/Engineer for approval prior to the use of any proposed reinforced fill material.

## 2.08 Geogrid Soil Reinforcement

- A. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high-density polyethylene. Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 g/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stripping.
- B.  $T_a$ , Long Term Allowable Tensile Design Load, of the geogrid material shall be determined as follows:
- $T_a = T_{ult} / (RF_{cr} * RF_d * RF_{id} * FS)$ 
    - $T_a$  shall be evaluated based on a 75-year design life.
    - $T_{ult}$ , Short Term Ultimate Tensile Strength shall be determined in accordance with ASTM D4595 or ASTM D6637.
      - $T_{ult}$  is based on the minimum average roll values (MARV).
    - $RF_{cr}$ , Reduction Factor for Long Term Tension Creep
      - $RF_{cr}$  shall be determined from 10,000-hour creep testing performed in accordance with ASTM D5262. Reduction value = 1.45 minimum.
    - $RF_d$ , Reduction Factor for Durability
      - $RF_d$  shall be determined from polymer specific durability testing covering the range of expected soil environments.  $RF_d = 1.10$  minimum.
    - $RF_{id}$ , Reduction Factor for Installation Damage
      - $RF_{id}$  shall be determined from product specific construction damage testing performed in accordance with ASTM D5818 (GRI-GG4). Test results shall be

provided for each product to be used with project specific or more severe soil type. RFid = 1.05 minimum.

- f. FS, Overall Design Factor of Safety
  - 1) FS shall be 1.5 unless otherwise noted for the maximum allowable working stress calculation.
- C. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection as limited by the "Hinge Height" divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with ASTM D6638 Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units (NCMA SRWU-1).
- D. Soil Interaction Coefficient,  $C_i$ 
  - 1.  $C_i$  values shall be determined per ASTM D6706 (GRI:GG5) at a maximum 0.75-inch (19 mm) displacement.
- E. Manufacturing Quality Control
  - 1. The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory.
    - a. The QC testing shall include:
      - 1) Tensile Strength Testing
      - 2) Melt Flow Index (HDPE)
      - 3) Molecular Weight (Polyester)

## **2.09 Drainage Pipe**

- A. If required, the drainage pipe shall be perforated or slotted PVC pipe manufactured in accordance with ASTM D-3034 or corrugated HDPE pipe manufactured in accordance with AASHTO M252.

## **2.10 Geotextile Filter Fabric**

- A. When required, Geotextile filter fabric shall be 4.0 oz/sy, polypropylene, needle punched nonwoven fabric.

# **PART 3 - EXECUTION**

## **3.01 Excavation**

- A. Contractor shall excavate to the lines and grades shown on the construction drawings. Owner's representative shall inspect the excavation and approve prior to placement of leveling material or fill soils. Proof roll foundation area as directed to determine if remedial work is required
- B. Over-excavation and replacement of unsuitable foundation soils and replacement with approved compacted fill will be compensated as agreed upon with the Owner.

### **3.02 Base Leveling Pad**

- A. Leveling pad material shall be placed to the lines and grades shown on the construction drawings, to a minimum thickness of 6 inches (150 mm) and extend laterally a minimum of 6" (150 mm) in front and behind the modular wall unit.
- B. Soil leveling pad materials shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557.

Leveling pad shall be prepared to insure full contact to the base surface of the concrete units.

### **3.03 Modular Unit Installation**

- A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions and insure that all units are in full contact with the base and properly seated.
- B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations
- C. Install shear/connecting devices per manufacturer's recommendations.
- D. Place and compact drainage fill within and behind wall units. Place and compact backfill soil behind drainage fill. Follow wall erection and drainage fill closely with structure backfill.
- E. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses.

### **3.04 Structural Geogrid Installation**

- A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignment.
- B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the construction design drawings or as directed by the Engineer.
- C. The geogrid shall be laid horizontally on compacted backfill and attached to the modular wall units. Place the next course of modular concrete units over the geogrid. The geogrid shall be pulled taut, and anchored prior to backfill placement on the geogrid.

Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100% coverage at each level. Spliced connections between shorter pieces of geogrid or gaps between adjacent pieces of geogrid are not permitted.

### **3.05 Reinforced Backfill Placement**

- A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage
- B. Reinforced backfill shall be placed and compacted in lifts not to exceed 6 inches (150 mm) where hand compaction is used, or 8 - 10 inches (200 to 250 mm) where heavy compaction equipment is used. Lift thickness shall be decreased to achieve the required density as required.
- C. C. Reinforced backfill shall be compacted to a minimum of 95 % Standard Proctor density per ASTM D-698 or 92% Modified Proctor Density per ASTM D1557. The moisture content of the backfill material prior to and during compaction shall be uniformly distributed throughout each layer and shall be dry of optimum, + 0%, - 3%.

- D. Only lightweight hand-operated equipment shall be allowed within 3 feet (1 m) from the tail of the modular concrete unit
- E. Tracked construction equipment shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 6 inches (150 mm) is required prior to operation of tracked vehicles over the geogrid. Tracked vehicle turning should be kept to a minimum to prevent tracks from displacing the fill and damaging the geogrid
- F. Rubber tired equipment may pass over geogrid reinforcement at slow speeds, less than 10 MPH (15 KPH). Sudden braking and sharp turning shall be avoided.
- G. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to direct runoff away from wall face. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

### **3.06 Cap Installation**

- A. Cap units shall be glued to underlying units with an all-weather adhesive recommended by the manufacturer

### **3.07 As-built Construction Tolerances**

- A. Vertical alignment:  $\pm 1.5$ " (40 mm) over any 10' (3 m) distance.
- B. Wall Batter: within 2 degrees of design batter.
- C. Horizontal alignment:  $\pm 1.5$ " (40 mm) over any 10' (3 m) distance. Corners, bends & curves:  $\pm 1$  ft (300 mm) to theoretical location.
- D. Maximum horizontal gap between erected units shall be  $\leq 1/2$  inch (13 mm).

### **3.08 Field Quality Control**

- A. Quality Assurance - The Owner shall/may engage inspection and testing services, including independent laboratories, to provide quality assurance and testing services during construction. This does not relieve the Contractor from securing the necessary construction quality control testing.
- B. Quality assurance should include foundation soil inspection. Verification of geotechnical design parameters, and verification that the contractor's quality control testing is adequate as a minimum. Quality assurance shall also include observation of construction for general compliance with design drawings and project specifications. (*Quality assurance is usually best performed by the site geotechnical engineer.*)
- C. Quality Control – The Contractor shall engage inspection and testing services to perform the minimum quality control testing described in the retaining wall design plans and specifications. Only qualified and experienced technicians and engineers shall perform testing and inspection services.
- D. Quality control testing shall include soil and backfill testing to verify soil types and compaction and verification that the retaining wall is being constructed in accordance with the design plans and project specifications.

**\*\*END OF SECTION\*\***

# SECTION 03055 CONCRETE FORMWORK

## PART 1 - GENERAL

### 1.01 Summary

- A. The work of this Section includes providing concrete formwork, bracing, shoring, and supports.
- B. Related Sections

<u>Section</u>	<u>Title</u>
Section 03200	Reinforcement Steel
Section 03290	Joints in Concrete Structures
Section 03300	Cast-in-Place Structural Concrete
Section 03310	Cast-in-Place Sitework Concrete
Section 03315	Grout

### 1.02 References

- A. Except as otherwise indicated, the current editions of the following apply to the work of this Section:

<u>Reference</u>	<u>Title</u>
PS 1	U.S. Product Standard for Concrete Forms, Class I
ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 318	Building Code Requirements for Reinforcing Concrete
ACI 347	Recommended Practice for Concrete Formwork

### 1.03 Submittals

- A. The following shall be submitted in compliance with Section 01300-Submittals:
  - 1. Falsework Calculations and Drawings: The Contractor's attention is directed to the provisions of the California Division of Industrial Safety, Construction Safety Orders, which requires that all falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a Civil Engineer, registered in the State of California; provided further, that a copy of the falsework plan or shoring layout shall be available on the job site at all times.
  - 2. Catalog information on:
    - a. Form ties and all related accessories, including taper tie plugs, if taper ties are used
    - b. Form gaskets
    - c. Form release ("bond breaker").

## **PART 2 - PRODUCTS**

### **2.01 General**

- A. Materials for concrete forms and falsework shall be new or in new condition.
- B. Except as otherwise expressly accepted, all lumber brought on the job site for use as forms, shoring, or bracing shall be new material or in new condition. All forms shall be smooth surface forms except as specified on contract drawings.

### **2.02 Form and Falsework Materials**

- A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
  - 1. Lumber shall be Douglas Fir or Southern Pine, construction grade or better, in conformance with U.S. Product Standard PS20.
  - 2. Plywood for concrete formwork shall be waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Pine plywood manufactured especially for concrete formwork and shall conform to the requirements of PS 1 for Concrete Forms, Class I, and shall be edge sealed.
  - 3. Form materials shall be metal, wood, plywood, or other approved material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade shown.
  - 4. Unless otherwise indicated, all exterior corners in concrete members shall be provided with 3/4-inch or 5/8-inch chamfers. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- B. Materials for formwork hardware and reinforcing spacers:
  - 1. All formwork hardware left inside the concrete shall have at least 2" clear cover.
  - 2. Concrete dobies are not permitted on the interior surface of fluid-containing structures.

## **PART 3 - EXECUTION**

### **3.01 General**

- A. Tolerances: The variation from established grade or lines shall not exceed the tolerances of ACI 117.
- B. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The Contractor shall assume full responsibility for the adequate design of all forms, and any forms which are unsafe or inadequate in any respect shall promptly be removed from the work and replaced at the Contractor's expense. A sufficient number of forms of each kind shall be provided to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by Contractor's personnel and by the Engineer and shall be in sufficient number and properly installed. During concrete placement, the Contractor shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- C. Concrete forms shall conform to the shape, lines, and dimensions of members as called for on the Drawings, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete within 1/8" at exposed surfaces and 1/4" elsewhere.

- D. At exposed surfaces, plywood, grain, or other formwork irregularities shall not imprint concrete surface.

### **3.02 Form Design**

- A. All forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on all forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.
- B. The forms shall be tight so as to prevent the loss of water, cement and fines during placing and vibrating of the concrete. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the Engineer. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03300-Cast-in-Place Structural Concrete. The size, number, and location of such form windows shall be acceptable to the Engineer.
- C. Form windows are required for wall pour depths greater than 25 feet tall. At least one window shall be provided for each pour, but no less than one per 60 linear feet of horizontal wall length.
- D. Forming systems for walls taller than 14 feet or horizontal spans greater than 16 feet require a formal and site-specific design and submittal, stamped by a licensed civil engineer.
- E. Forms and falsework to support the roof and floor slabs shall be designed based on nationally recognized standards, but in no circumstance be less than the total dead load, plus a live load of 50 psf for horizontal surfaces, and a lateral load of 100 lbs per foot at top of forms.
- F. Lateral pressures used for form design shall conform to ACI 347-latest edition, but in no case be less than 60 lbs per cubic foot multiplied by the depth of the forms for continuous pours.

### **3.03 Construction**

- A. Vertical Surfaces: All vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is shown. Not less than 1-inch of concrete shall be added to the thickness of the concrete member as shown where concrete is permitted to be placed against trimmed ground in lieu of forms. Where soil slope or face cannot hold its shape during concrete operations, formwork shall be used.
- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those shown or specified, except as may be acceptable to the Engineer. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete.
- C. Pipe stubs and anchor bolts shall be set in the forms where required.
- D. Form Ties
  - 1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar as indicated in Section 03300-Cast-in-Place Structural Concrete. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties which cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel

panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1.5 inches back from the formed face or faces of the concrete.

2. Removable Ties: The larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls that are dry on both sides. Exposed faces of walls shall have the outer 2 inches of the exposed face filled with a polymer-modified cement grout that shall match the color and texture of the surrounding wall surface.
3. Factor of safety = 2.0 against tensile failure.

### **3.04 Reuse of Forms**

- A. Forms may be reused only if in good condition and only if acceptable to the Engineer. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on all exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces that are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the Engineer.

### **3.05 Removal of Forms**

- A. Careful procedures for the removal of forms shall be strictly followed, and this work shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28-day strength specified in Section 03300-Cast-in-Place Structural Concrete; provided, that no forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the specified 28-day strength and has been in place for a minimum of 7 days. The time required to establish said strength shall be as determined by test cylinder results from concrete used in the first pour. If the time so determined is more than the 7-day minimum, then that time shall be used as the minimum length of time. Forms for all vertical walls and columns shall remain in place at least 1 day after the concrete has been placed, provided that average air temperature is between 10 degrees F and 115 degrees F and concrete has sufficient strength to maintain form.
- B. Apply curing as required after form removal.

### **3.06 Maintenance of Forms**

- A. Forms shall be cleaned, treated with a releasing agent, and maintained in accordance with ACI 347 and the following. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the Engineer. Any excess lubricant shall be satisfactorily removed before placing the concrete. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

### **3.07 Falsework**

- A. Falsework, including staging, walkways, forms, ladders, and similar appurtenances, shall be designed, engineered, constructed, and maintained according to the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, and the requirements of the Construction Safety Orders of the California Division of Industrial Safety.

**\*\*END OF SECTION\*\***

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## **SECTION 03060 EPOXY BONDING**

### **PART 1 - GENERAL**

#### **1.01 Summary**

- A. Section includes: Bonding reinforcing bars and all thread rods in concrete using epoxy adhesive or epoxy mortar.
- B. Related sections
  - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
  - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
  - 3. The following Sections are related to the Work described in this Section. This list of Related Sections is provided for convenience only and is not intended to excuse or otherwise diminish the duty of the Contractor to see that the completed Work complies accurately with the Contract Documents.
    - a. Section 03200 – Reinforcement Steel.

#### **1.02 References**

- A. The following documents are a part of this section insofar as they are specified and modified herein. In case of conflict between the requirements of this Section, and the following documents, the requirements of this section shall prevail.
- B. American National Standards Institute (ANSI):
  - 1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.
- C. ASTM international (ASTM):
  - 1. C 881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- D. ICC Evaluation Service, Inc. (ICC-ES):
  - 1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- E. Society for Protective Coatings (SSPC):
  - 1. Surface Preparation Standards (SP)
    - a. SP-1 - Solvent Cleaning.

#### **1.03 Submittals**

- A. Product Data: Furnish technical data for epoxy adhesives, including:
  - 1. Installation instructions.
  - 2. Independent laboratory test results.
  - 3. Handling and storage instructions.
- B. Quality control submittals:
  - 1. Epoxy Manufacturer's past project experience data on at least 3 similar projects supplied with proposed products within the last 3 years.

2. Special inspection: Provide detailed step-by-step instructions for the special inspection procedure in accordance with the building code.
3. ICC Evaluation Service, Inc., Evaluation Services Report in compliance with the AC308-Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
  - a. Evaluation for cracked and uncracked concrete for static, wind, and seismic loads.

#### **1.04 Delivery, Storage, & Handling**

- A. Storage and protection.
  1. Store epoxy components on pallets or shelving in a covered-storage area at 77-degrees F.
  2. Control temperature above 60 degrees Fahrenheit and dispose of product if shelf life has expired.
  3. If stored at temperatures below 60 degrees Fahrenheit, test components prior to use to determine if they still meet specified requirements.

### **PART 2 - PRODUCTS**

#### **2.01 General**

- A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

#### **2.02 Epoxy Adhesive for Self-Contained Cartridge System**

- A. Epoxy adhesive shall have a current ICC Evaluation Service report documenting acceptance under AC308 for use with cracked concrete and for the seismic design categories specified.

##### **B. Materials**

1. In accordance with ASTM C 881, Type IV, Grade 3, Class B or C depending on site conditions.
2. 2-component, 100 percent solids, insensitive to moisture.
3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

##### **C. Packaging.**

1. Furnished in side-by-side cartridges with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle. Nozzle designed to thoroughly blend the components for injection from the nozzle directly into prepared hole.
2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

##### **D. Manufacturers: One of the following or equal:**

1. Hilti, Inc., Tulsa, OK: HIT-RE 500 V3.
2. Simpson Strong-Tie Company, Inc., Pleasanton, CA: SET-XP.

#### **2.03 Thread Rods**

##### **A. 316 Stainless Steel**

1. Materials: Meeting the requirements of ASTM F593.

## **2.04 Reinforcing Bars**

- A. As specified in Section 03200 – Reinforcement Steel.

## **PART 3 - EXECUTION**

### **3.01 General**

- A. Provide Epoxy Adhesive Packaged as follows:
  - 1. Disposable, self-contained cartridge system capable of dispensing both epoxy components in the proper mixing ratio and fit into a manually or pneumatically operated caulking gun.
  - 2. Dispense components through a mixing nozzle that thoroughly mixes components.

### **3.02 Hole Sizing and Installation**

- A. Drilling holes:
  - 1. Determine location of reinforcing bars or other obstructions with a nondestructive indicator device, and mark locations with construction crayon on the surface of the concrete.
  - 2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.
- B. Hole drilling equipment:
  - 1. Electric or pneumatic rotary impact type with medium or light impact.
  - 2. Drill bits: Carbide-tipped in accordance with ANSI B212-15.
  - 3. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.
  - 4. Where edge distances are less than 2 inches, use lighter impact equipment to prevent microcracking and concrete spalling during drilling process.
- C. Hole diameter: Reinforcing bar diameter or all thread rod diameter plus 1/8 inch.
- D. Obstructions in drill path:
  - 1. If an existing reinforcing bar or other obstruction is hit while drilling hole, stop drilling hole and fill the hole with drypack mortar. Relocate the hole to miss the obstruction and drill another hole. Repeat the above until the hole has been drilled to the required depth.
  - 2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the structural member and endanger the stability of the structure. Drypack holes which hit obstructions and allow drypack to reach strength equal to the existing concrete before drilling adjacent holes. Epoxy grout may be substituted for drypack when acceptable to Engineer.
  - 3. When existing reinforcing steel is encountered during drilling and when acceptable to Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter.
  - 4. Bent bar reinforcing bars: Where edge distances are critical, and striking reinforcing steel is likely, and if acceptable to Engineer, drill hole at 10 degree angle or less from axis of reinforcing bar or all thread rod being installed.
- E. Install reinforcing bars and all thread rods to depth, spacings, and locations as indicated on the Drawings.
  - 1. Do not install epoxy bonded all-thread rods or reinforcing bars in overhead applications.

F. Cleaning holes:

1. Insert long air nozzle into hole and blow out loose dust. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
2. Use a stiff bristle brush to vigorously brush hole to dislodge compacted drilling dust.
3. Repeat step 1.
4. Repeat above steps as required to remove drilling dust or other material that will reduce bond. The hole shall be clean and dry.

G. Cleaning reinforcing bars and all thread rods:

1. Solvent clean reinforcing bar and all thread rods over the embedment length in accordance with SSPC SP-1 Solvent Cleaning. Provide an oil and grease free surface to promote bonding of adhesive to steel.
2. Clean reinforcing bars and all thread rods over embedment length to bare metal. The reinforcing bars and all thread rods shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.

H. Filling hole with epoxy:

1. Fill hole with epoxy before inserting the reinforcing bar or all thread rod. Fill hole with epoxy starting from bottom of hole. Fill hole without creating air voids.
2. Fill hole with sufficient epoxy so that excess epoxy is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.
3. Do not install epoxy prior to receiving epoxy manufacturer's onsite training.

### **3.03 Manufacturer's Services**

- A. Furnish manufacturer's representative to conduct jobsite training for proper installation, handling, and storage of epoxy, for personnel who will perform actual installation. Engineer may attend training sessions.

### **3.04 Field Quality Control**

A. Testing laboratory hired by Owner will:

1. Review epoxy manufacturer's recommended special inspection procedures.
2. Periodically inspect hole-drilling operations for conformance with Contract Documents and manufacturer's recommendations.
3. Certify in writing to the Engineer that depth and location of holes conform to the requirements in the Contract Documents prior to placement of epoxy.
4. Continuously inspect placement of epoxy and reinforcing bars installation.

**\*\*END OF SECTION\*\***

## SECTION 03200 REINFORCEMENT STEEL

### PART 1 - GENERAL

#### 1.01 Summary

A. The work of this Section includes providing all concrete reinforcement steel, welded wire fabric, couplers, and concrete inserts for use in reinforced concrete and masonry construction, including all the wires, clips, supports, chairs, spacers, and other accessories.

#### 1.02 References

<u>Reference</u>	<u>Title</u>
ACI 117	Specification for Tolerances for Concrete Construction and Materials
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 318	Building Code Requirements for Reinforced Concrete
CRSI MSP-1	Concrete Reinforcing Steel Institute Manual of Standard Practice
WRI	Manual of Standard Practice for Welded Wire Fabric
AWS D1.4	Structural Welding Code - Reinforcing Steel
ASTM A82	Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A185	Specification for Welded Steel Wire Fabric For Concrete Reinforcement
ASTM A615	Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A706	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
ASTM A775	Specification for Epoxy-Coated Reinforcing Steel Bars
Caltrans	Caltrans Standard Specifications Section 52
PCWA	PCWA Improvement Standards, Standard Specifications, Standard Drawings

#### 1.03 Submittals

A. The following shall be submitted in accordance with Section 01330 - Submittals:

1. Reinforcing Shop Drawings
  - 1) Bill of Materials
  - 2) Placing Drawing
  - 3) Splices
  - 4) Mechanical Splices
  - 5) Shop Bending Diagrams
  - 6) Embeds
  - 7) Anchor Bolts
  - 8) Sleeves

9) Gates

10) Conduits

11) Dowels

2. General contractor shall coordinate all of the various discipline and subcontractor submittal prior to submitting for review by the engineer of record.
3. Mill certificates for all reinforcing at time of site delivery.
4. Proof of CRSI membership, or equivalent trade membership.

- B. Details of the concrete reinforcement steel and concrete inserts shall be submitted by the Contractor at the earliest possible date. Details of reinforcement steel for fabrication and erection shall conform to ACI 315 and the requirements indicated. The shop bending diagrams shall show the actual lengths of bars, to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. The shop drawings shall include bar placement diagrams that clearly indicate the dimensions of each bar splice.
- C. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, manufacturer's literature shall be submitted which contains instructions and recommendations for installation for each type of coupler used; furnish current research reports by ICC.
- D. If reinforcement steel is spliced by welding at any location, the Contractor shall use ASTM A706 reinforcing. All welding shall comply with AWS D1.4. The Contractor shall submit a written welding procedure ("WPS") for each type of weld for each size of bar which is to be spliced by welding.

#### **1.04 Storage**

- A. Reinforcing, embeds and accessories shall be kept clean and free from dirt or grease.

### **PART 2 - PRODUCTS**

#### **2.01 Reinforcement Steel**

- A. Reinforcement steel for all cast-in-place reinforced concrete construction shall conform to the following requirements:
1. All reinforcement steel shall conform to Caltrans Section 52 and these additional requirements.
  2. Bar reinforcement shall conform to the requirements of ASTM A615 or A706, Grade 60 Billet Steel Reinforcement minimum.
  3. Welded wire fabric reinforcement shall conform to the requirements of ASTM A185 or deformed ASTM A497 and as indicated; provided, that welded wire fabric with longitudinal wire of W4 size wire and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches; and provided further, that welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.
- B. Accessories
1. Accessories shall include all necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. All bar supports shall meet the requirements of the CRSI Manual of Standard Practice including special requirements for supporting epoxy coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating. Plastic shall be gray in color.
  2. Wire for tying reinforcement shall be 18 ga. or heavier, black annealed.

3. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located, and be used for horizontal bars at grade only. Wire ties shall be embedded in concrete block bar supports. Concrete blocks shall not be used on the inside face of hydraulic structures.
4. Epoxy coating for reinforcing and accessories, where specified or shown, shall conform to ASTM A775.

**2.02 Mechanical Couplers**

- A. Mechanical couplers shall be provided where shown and where approved. The couplers shall be Type 2, as determined by ACI 318.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.
- C. Approved couplers are Bar-Lock (Dayton) or Xtender (HRC) or equal.

**PART 3 - EXECUTION**

**3.01 General**

- A. All reinforcement steel, welded wire fabric and other reinforcement shall be free of materials deleterious to bond. Minor rust that is not scaling or loose is acceptable.

**3.02 Fabrication**

- A. Reinforcement steel shall be accurately formed to the dimensions and shapes shown, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318, except as indicated. Bars shall be bent cold.
- B. Fabricating Tolerances: Bars used for concrete reinforcement shall meet the fabricating tolerances defined in ACI 315.

**3.03 Placing**

- A. Reinforcement steel shall be accurately positioned and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers that are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties that are embedded in the blocks. For concrete over formwork, the Contractor shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. Limitations on the use of bar support materials shall be as follows.
  1. Concrete Dobies: permitted at all locations except where architectural finish is required, or at interior side of fluid-containing wall.
  2. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
  3. Plastic Bar Supports: permitted at all locations except on grade.
- C. Minimum concrete coverage for steel reinforcement:

<b>Concrete exposure</b>	<b>Min Reinforcing Steel Cover (inches)</b>
--------------------------	---

Cast against and exposed to soil	3
Exposed to weather or water	2
All other applications	1 ½

- D. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
- E. Unless otherwise specified, reinforcement placing tolerances shall be within the limits specified in ACI 318 and ACI 117.
- F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to the approval of the Engineer.
- G. Welded wire fabric reinforcement placed over horizontal forms shall be supported on slab bolsters. Slab bolsters shall be spaced not more than 30 inches on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.
- H. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.
- I. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Non-abrasive slings made of nylon and similar materials shall be used. Specially coated bar supports shall be used. All chips or cracks in the epoxy coating shall be repaired with a compatible epoxy repair material prior to placing concrete.
- J. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.
- K. Tack welding of reinforcing bar is prohibited.

### 3.04 Splicing

- A. General: Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where shown, locations and details shall be included on shop drawings.
- B. Bending or Straightening: Reinforcement shall not be straightened or rebent in a manner that will injure the material. Bars with kinks or bends not shown shall not be used. All bars shall be bent cold, unless otherwise permitted by the Engineer. Bars partially embedded in concrete may be field-bent one time at an angle up to 30 degrees, and bent back to its original position. Rebending more than once will render the bar unacceptable. Unless Plans show otherwise, allow at least 40 bar diameters overlap on splices for deformed bars.
- C. Couplers that are located at a joint face shall be a type that can be set either flush or recessed from the face as shown. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface. After the concrete is placed, the coupler shall be plugged with plastic plugs that have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials. Threaded couplers shall be plugged. Maintain minimum edge distance and concrete cover. Couplers shall be installed as required by manufacturer.

### **3.05 Cleaning and Protecting**

- A. Reinforcement steel shall at all times be protected from conditions conducive to corrosion until concrete is placed around it. Mild non-flaking surface rust is acceptable.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be reinspected and, if necessary recleaned.

### **3.06 Inspection**

- A. Testing Agency shall be provided at least 24 hours advance notice to schedule inspections as required by the contract drawings and building code.

**\*\*END OF SECTION\*\***

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**SECTION 03290**  
**JOINTS IN CONCRETE STRUCTURES**

**PART 1 - GENERAL**

**1.01 Summary**

- A. The work of this Section includes providing the construction joints, contraction joints, expansion joints, and control joints in structural concrete, including waterstops, joint fillers, and joint sealants.
- B. Related Sections

<u>Section</u>	<u>Title</u>
Section 03100	Concrete Formwork
Section 03200	Reinforcement Steel
Section 03300	Cast-in-Place Structural Concrete

**1.02 References**

- A. Except as otherwise indicated, the current editions of the following apply to the work of this Section.

<u>Reference</u>	<u>Title</u>
ACI 224.3	Joints in Concrete Construction.
ASTM C 920	Specification for Elastomeric Joint Sealants.
ASTM D 412	Test Method for Rubber Properties in Tension.
ASTM D 638	Test Method for Tensile Properties of Plastics.
ASTM D 746	Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
ASTM D747	Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
ASTM D1751	Preformed Expansion Joint Fillers for concrete paving and Structural Construction (non extruding and resilient bituminous types)
TT-S-0227E(3)	Sealing Compound, Elastomeric Type, Multi-component for Caulking, Sealing, and Glazing Buildings and Other Structures.
ASTM D624	Test Method for Rubber Property - Tear Resistance
ASTM D1056	Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1752	Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D2240	Test Method for Rubber Property - Durometer Hardness
CRD-C572	PVC Waterstop
TT-S-0227E(3)	Sealing Compound, elastomeric type, Multi-component for Caulking, Sealing, and Glazing Buildings and Other Structures

### **1.03 Definitions**

- A. Construction Joints: When fresh concrete is placed against a concrete surface, with or without reinforcement, the joint between the two pours is called a construction joint. Unless noted by contract drawings, construction joints transfer full stresses across joint.
- B. Contraction Joints: Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the first pour, which shall be coated with a bond breaker applied to a smooth, non-keyed surface. A portion of the slab on-grade reinforcement may be stopped 3 inches from the joint to allow shrinkage of the concrete of the second pour. Waterstop and/or sealant groove shall also be provided when specified or shown.
- C. Expansion Joints: To allow the concrete to expand freely, a space is provided between the two pours, the joint shall be formed as shown. This space is obtained by placing a filler joint material against the first pour, which acts as a form for the second pour. Unless otherwise specified, all expansion joint shall be provided with a center-bulb type waterstop.
  - 1. Premolded expansion joint material shall be installed with the edge at the indicated distance below or back from finished concrete surface, and shall have a slightly tapered, dressed, and oiled wood strip secured to or placed at the edge thereof during concrete placement, which shall later be removed to form space for sealing material.
  - 2. The space so formed shall be filled with a joint sealant material. In order to keep the two wall or slab elements in line the joint shall also be provided with a sleeve-type dowel as shown on the contract drawings.

### **1.04 Submittals**

- A. The following shall be submitted in compliance with Section 01300-Submittals:
- B. Waterstops: Prior to production of the material required under this contract, qualification samples shall be submitted. Such samples shall consist of extruded or molded sections of each size or shape to be used, and shall be accomplished so that the material and workmanship represents in all respects the material to be furnished under this contract. The balance of the material to be used under this contract shall not be produced until after the Engineer has reviewed the qualification samples.
- C. Waterstop Samples: Prior to use of the waterstop material in the field, a sample of a fabricated mitered cross and a tee constructed of each size or shape of material to be used shall be submitted. These samples shall be fabricated so that the material and workmanship represent in all respects the fittings to be furnished under this contract.
- D. Joint Sealant: Prior to ordering the sealant material, the Contractor shall submit sufficient data to show general compliance with the requirements of the Contract Documents.
- E. Joint Location: The Contractor shall submit placement shop drawings showing the location and type of all joints for each structure where not shown on the Contract Documents.
- F. Certified test reports from the sealant manufacturer on the actual batch of material being supplied indicating compliance with the above requirements shall be furnished before the sealant is used on the job.
- G. Shipping Certification: The Contractor shall provide written certification from the manufacturer as an integral part of the shipping form, to show that all of the material shipped to this project meets or exceeds the physical property requirements of the Contract Documents.

### **1.05 Services of Manufacturer**

- A. Before work is commenced, the Contractor shall arrange for a representative of the sealant manufacturer to instruct the crew doing the work on the proper methods of mixing and applying the sealant.

### **1.06 Inspection and Testing**

- A. Waterstop Inspection: It is required that all waterstop field joints shall be subject to inspection, and no such work shall be scheduled or started without having made prior arrangements schedule required inspections.
- B. All field joints in waterstops shall be subject to rigid inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects that would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which shall pass said inspection, and all faulty material shall be removed from the site and disposed of by the Contractor at its own expense.
- C. Construction Joint Sealant: The Contractor shall prepare adhesion and cohesion test specimens as specified herein, at intervals of 5 working days while sealants are being installed.
- D. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:
  - 1. Sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch). Spacing between the blocks shall be 1-inch. Coated spacers (2-inch by 1-1/2-inch by 1/2-inch) shall be used to insure sealant cross-sections of 1/2-inch by 2 inches with a width of 1-inch.
  - 2. Sealant shall be cast and cured according to manufacturer's recommendations except that curing period shall not exceed 24 hours.
  - 3. Following curing period, the gap between blocks shall be widened to 1-1/2-inch. Spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

### **1.07 Guarantee and Maintenance**

- A. The Contractor shall provide a 5-year written guarantee of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that it agrees to repair or replace, to the satisfaction of the Owner, at no additional cost to the Owner, any such defective areas which become evident within said 5-year guarantee period.

## **PART 2 - PRODUCTS**

### **2.01 General**

- A. All joint materials specified herein shall be classified as acceptable for potable water use by EPA or NSF.

### **2.02 PVC Waterstops**

- A. General:
  - 1. Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements of these Specifications. No reclaimed or scrap material shall be used.
  - 2. Retrofit waterstops shall conform to these requirements.

- B. Flatstrip and Center-Bulb Waterstops: Flatstrip and center-bulb waterstops shall be as indicated; provided, that at no place shall the thickness of flat strip waterstops, including the center bulb type, be less than 3/8-inch.
- C. Multi-Rib Waterstops: Multi-rib waterstops, where required, shall be as indicated. Prefabricated joint fittings shall be used at all intersections of the ribbed-type waterstops.
- D. Waterstop Testing Requirements: When tested in accordance with the specified test standards, the waterstop material shall meet or exceed the following requirements:

<b>Physical Property, Sheet Material</b>	<b>Value</b>	<b>ASTM Standard</b>
Tensile Strength-min (psi)	1750	D638, Type IV
Ultimate Elongation-min (percent)	350	D638, Type IV
Low Temperature Brittleness-Maximum (between 10 degrees F and 115 degrees F)	-35	D746
Stiffness in Flexure-min (psi)	400	D747
Accelerated Extraction (CRD-C572)	1500	D638, Type IV
Effect of Alkalies (CRD-C572)	+0.25/-0.10	-
Hardness, Shore A		D2240

### 2.03 Joint Sealant

- A. Joint sealant shall be polyurethane polymer designed for bonding to concrete that is continuously submerged in water. No material will be acceptable which has an unsatisfactory history as to bond or durability when used in the joints of water retaining structures.
- B. Joint sealant material shall meet the following requirements (between 10 degrees F and 115 degrees F and 50 percent Relative Humidity):

Work Life	45 - 180 minutes
Time to Reach 20 Shore "A" Hardness (between 10 degrees F and 115 degrees F, 200 gr quantity)	24 hours, maximum
Ultimate Hardness (ASTM D 2240)	20 - 45 Shore "A"
Tensile Strength (ASTM D 412)	200 psi, minimum
Ultimate Elongation (ASTM D 412)	400 percent, minimum
Tear Resistance (Die C ASTM D 624)	75 pounds per inch of thickness, minimum
Color	Light Gray

- C. All polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:
  1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ANSI/ASTM C920 Type M or Federal Specification TT-S-00227 E(3) for 2-part material, as applicable.

2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used; all such compounds shall conform to the requirements of ANSI/ASTM C920 Class 25, Grade NS, or Federal Specification TT-S-0027 E(3), Type II, Class A.
  3. For plane horizontal joints, the self-leveling compounds which meet the requirements of ANSI/ASTM C920 Class 25, Grade P, or Federal Specification TT-S-0027 E(3), Type I shall be used. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics, and having a Shore "A" hardness range of 35 to 45, shall be used.
- D. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the sealant manufacturer.
  - E. Sealants for non-waterstop joints in concrete shall conform to the requirements of Section 07900-Sealants.

#### **2.04 Joint Materials**

- A. Bearing Pad: Bearing pad to be neoprene conforming to ASTM D1752 Type I, 40 Durometer hardness unless otherwise noted.
- B. Neoprene Sponge: Sponge to be neoprene, closed-cell, expanded, conforming to ASTM D1056, type RE-45-E1, with a compression deflection, 25 percent deflection (limits), 119 to 168 kPa (17 to 24 psi) minimum.
- C. Preformed Joint Filler: Preformed joint filler material shall be of the preformed non-extruding type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Bituminous fiber type will not be permitted. All non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D1752 for Type I, except as otherwise specified herein.

#### **2.05 Backing Rod**

- A. Backing rod shall be an extruded closed-cell, polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi. The rod shall be 1/8-inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

#### **2.06 Bond Breaker**

- A. Bond breaker shall not be used except as detailed. Brush-on application shall not be substituted for bond-breaker tape.

#### **2.07 Bentonite Waterstop**

- A. Where called for, bentonite type waterstop, which shall expand in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast, shall be provided.
- B. The bentonite waterstop shall be composed of 75 percent bentonite. The balance of the material shall be butyl rubber-hydrocarbon with less than 1.0 percent volatile matter. The waterstop shall contain no asbestos fibers or asphaltics.
- C. The manufacturer's rated application temperature range shall be from between 10 degrees F and 115 degrees F. The service temperature range shall be from between 10 degrees F and 115 degrees F.
- D. The waterstop shall be provided with an adhesive backing which will provide adhesion to concrete surfaces.

## **2.08 Slip Dowels**

A. Slip dowels in joints shall be smooth hot-dip galvanized steel (A36).

## **2.09 Manufacturers**

A. Products shall be manufactured by one of the following (or equal):

1. Flatstrip and Center-Bulb Waterstops
  - a. Kirkhill Rubber Company
  - b. Water Seals, Incorporated
  - c. Greenstreak Plastic Products Company
  - d. Sika Corporation
2. Multi-Rib Waterstops
  - a. Water Seals, Incorporated
  - b. Greenstreak Plastic Products Company
  - c. Sika Corporation
3. Sealants
  - a. Elastothane 227R by Pacific Polymers
  - b. Sikaflex 2C by Sika Corporation
4. Bond Breaker
  - a. Super Bond Breaker by Burke Company
  - b. 3M Bond Breaker tape

B. Retrofit waterstops may be flatstrip and center-bulb or multi-rib type.

## **PART 3 - EXECUTION**

### **3.01 Waterstops - General**

- A. Waterstops of the type specified herein shall be embedded in the concrete across joints as shown. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstops. The Contractor shall take suitable precautions and means to support and protect the waterstops during the progress of the work and shall repair or replace at its own expense any waterstops damaged during the progress of the work. All waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- B. When any waterstop is installed in the concrete on one side of a joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure and until the exposed portion of the waterstop is embedded in concrete.

### **3.02 Splices in Waterstops**

A. Splices in waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:

1. The material not be damaged by heat sealing.
  2. The splices have a tensile strength of not less than 60 percent of the unspliced materials tensile strength.
  3. The continuity of the waterstop ribs and of its tubular center axis be maintained.
- B. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- C. All joints with waterstops involving more than 2 ends to be jointed together, and all joints which involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections shall be prefabricated by the Contractor prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt welded to the straight run portions of waterstop in place in the forms.
- D. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

### **3.03 Joint Construction**

#### **A. Setting Waterstops**

1. To eliminate faulty installation that may result in joint leakage, particular care shall be taken of the correct positioning of the waterstops during installation. Adequate provisions must be made to support and anchor the waterstops during the progress of the work and to insure the proper embedment in the concrete. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints. The center axis of the waterstops shall be coincident with the joint openings. Maximum density and imperviousness of the concrete shall be insured by thoroughly working it in the vicinity of all joints.
  2. In placing flat-strip waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed. Unless otherwise shown, all waterstops shall be held in place with continuous wood formwork. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked. In placing concrete around horizontal waterstops, with their flat face in a horizontal plane, concrete shall be worked under the waterstops by hand so as to avoid the formation of air and rock pockets.
  3. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.
  4. Waterstop in vertical wall joints shall stop 6 inches from the top of the wall where such waterstop does not connect with any other waterstop and is not to be connected to for a future concrete placement.
- B. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:
1. Offsets at joints greater than 1/4-inch or 15 percent of material thickness, at any point, whichever is less.
  2. Exterior crack at joint, due to incomplete bond, which is deeper than 1/16-inch or 15 percent of material thickness, at any point, whichever is less.
  3. Any combination of offset or exterior crack which will result in a net reduction in the cross section of the waterstop in excess of 1/16-inch or 15 percent of material thickness at any point, whichever is less.

4. Misalignment of joint that results in misalignment of the waterstop in excess of 1/2-inch in 10 feet.
  5. Porosity in the welded joint as evidenced by visual inspection.
  6. Bubbles or inadequate bonding that can be detected with a penknife test. (If, while prodding the entire joint with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)
- C. Joint Location: Construction joints, and other types of joints, shall be provided where shown. When not shown, construction joints shall be provided at 25-foot maximum spacing for all concrete construction, unless noted otherwise. Where joints are shown spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing. The location of all joints, of any type, shall be submitted to the Engineer for acceptance.
- D. Joint Preparation: Special care shall be used in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required. Unless otherwise shown, such bonding will be required at all horizontal joints in walls. Surfaces shall be prepared as required.
- E. Construction Joint Sealant
1. Where groove and sealant is noted on the Drawings, construction joint shall be provided with tapered grooves that shall be filled with a construction joint sealant. The material used for forming the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant. After removing the forms from the grooves, all laitance and fins shall be removed, and the grooves shall be sand-blasted. The grooves shall be allowed to become thoroughly dry, after which they shall be blown out; immediately thereafter, they shall be primed, bond breaker tape placed in the bottom of the groove, and filled with the construction joint sealant. The primer used shall be supplied by the same manufacturer supplying the sealant. No sealant will be permitted to be used without a primer. Care shall be used to completely fill the sealant grooves. Areas designated to receive a sealant fillet shall be thoroughly cleaned, as outlined for the tapered grooves, prior to application of the sealant.
  2. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance that would interfere with proper bonding of the sealant. All sealant shall achieve final cure at least 7 days before the structure is filled with water.
  3. All sealant shall be installed by a competent waterproofing specialty Contractor who has a successful record of performance in similar installations.
  4. Thorough, uniform mixing of 2-part, catalyst-cured materials is essential; special care shall be taken to properly mix the sealer before its application.
  5. Any joint sealant which, after the manufacturer's recommended curing time for the job conditions of the work hereunder, fails to fully and properly cure shall be completely removed; the groove shall be thoroughly sandblasted to remove all traces of the uncured or partially cured sealant and primer, and shall be re-sealed with the specified joint sealant. All costs of such removal, joint treatment, re-sealing, and appurtenant work shall be at the expense of the Contractor.
- F. Bentonite Waterstop:
1. Where a bentonite waterstop is called for, it shall be installed with the manufacturer's instructions and recommendations; except, as modified herein.

2. Bentonite waterstop shall only be used where complete confinement by concrete is provided. Bentonite waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of any intersecting joint.
3. The bentonite waterstop shall be located as near as possible to the center of the joint and it shall be continuous around the entire joint. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
4. Where the thickness of the concrete member to be placed on the bentonite waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete. The groove shall be at least 3/4 inch deep and 1-1/4 inches wide. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2.5 inches.
5. Where a bentonite waterstop is used in combination with PVC waterstop, the bentonite waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be placed in contact with the PVC waterstop.
6. The bentonite waterstop shall not be placed when the temperature of the waterstop material is below 40 degrees F. The waterstop material may be warmed so that it shall remain between 10 degrees F and 115 degrees F during placement; however, means used to warm the material shall in no way harm the material or its properties. The waterstop shall not be installed where the air temperature falls outside the manufacturer's recommended range.
7. The concrete surface under the bentonite waterstop shall be smooth and uniform. The concrete shall be ground smooth if needed. Alternately, the bentonite waterstop shall be bonded to the surface using an epoxy grout that completely fills all voids and irregularities beneath the waterstop material. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.
8. The bentonite waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing. This shall be in addition to the adhesive backing provided with the waterstop.

**\*\*END OF SECTION\*\***

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## SECTION 03300 CAST-IN-PLACE STRUCTURAL CONCRETE

### PART 1 - GENERAL

#### 1.01 Summary

##### A. Section Includes

1. Cast-in-place structural reinforced concrete
2. Concrete accessories

##### B. Related Sections

<u>Section</u>	<u>Title</u>
Section 02667	Testing of Hydraulic Structures
Section 03100	Concrete Formwork
Section 03200	Reinforcement Steel
Section 03280	Joints in Concrete Pavement
Section 03290	Joints in Concrete Structures
Section 03315	Grout
Section 03400	Precast Concrete
Section 07900	Sealants
Section 09900	Coatings

#### 1.02 References

##### A. American Concrete Institute (ACI)

<u>Reference</u>	<u>Title</u>
ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete for Buildings
ACI 304	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 308	Guide to Curing Concrete
ACI 309	Consolidation of Concrete
ACI 318	Building Code Requirements for Structural Concrete
ACI 350	Environmental Engineering Concrete Structures

##### B. American Society for Testing and Materials (ASTM)

<u>Reference</u>	<u>Title</u>
ASTM C31	Practices for Making and Curing Concrete Test Specimens in the Field
ASTM C33	Specification for Concrete Aggregates

ASTM C39	Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C94	Specification for Ready-Mixed Concrete
ASTM C143	Test Method for Slump of Portland Cement Concrete
ASTM C150	Specification for Portland Cement
ASTM C157	Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete
ASTM C172	Standard Method of Sampling Freshly Mixed Concrete
ASTM C192	Method of Making and Curing Concrete Test Specimens in the Laboratory
ASTM C260	Specification for Air-Entraining Admixtures for Concrete
ASTM C289	Test Method For Potential Reactivity of Aggregates (Chemical Method)
ASTM C309	Specifications for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C494	Specification for Chemical Admixtures for Concrete
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C1077	Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction & Criteria for Laboratory Evaluation

### 1.03 Definitions

- A. "Contractor" includes the general contractor in direct contract with the owner, subcontractor, or any tradesman responsible for construction.
- B. "Owner's Representative" includes the Inspector, Engineer of Record, or Construction Manager representing the owner's interests, and not directly compensated by the Contractor.
- C. "Cold Weather" is defined as a period when, for more than 3 consecutive days, the following conditions exist:
  - 1. Average daily air temperature is less than 40 F degrees (5 C) and
  - 2. Air temperature is not greater than 50 F degrees (10 C) for more than one-half of any 24-hour period.
- D. "Hot weather" is defined by any one of the following conditions:
  - 1. Ambient air temperature above 90 F degrees (32 C).
- E. "Mass Concrete" refers to single pour cast-in-place concrete that is greater than 2'-10" thick, or is 2'-6" thick or greater, with an area larger than 500 square feet.

### 1.04 Submittals

- A. General: All submittals must be provided for Engineer of Record approval at least 3 weeks prior to construction.
- B. Submit concrete mix design for each concrete type per ACI 301:
  - 1. Mix proportions
  - 2. Concrete materials
  - 3. Admixtures
  - 4. Water test results

- 5. Waterstop samples for hydraulic structures
- C. Shrinkage test results from prior test mixes per ASMT C157 for hydraulic structures.
- D. Curing methods and product data per ACI 301.
- E. Repair procedures for repair per ACI 224.1 and ACI 301.
- F. Special procedures for hot weather concreting.
- G. Special procedures for cold weather concreting.
- H. Special procedures for mass concrete.

### **1.05 Quality Assurance**

- A. Qualifications: All foremen supervising construction shall have a minimum of 3 years experience in similar work, and at least 3 previous projects of similar type, and shall be familiar with ACI 301.
- B. Field Testing
  - 1. Daily inspection written reports shall be provided to the Owner's Representative and Engineer of Record providing detailed information of work completed within 24 hours.
  - 2. During concrete placement, the following duties shall be performed by the Inspector:
    - a. Ambient air temperature test
    - b. Concrete temperature test
    - c. Concrete slump test
    - d. Collection of samples for lab testing
    - e. Confirm accuracy of batch ticket
  - 3. Pre-pour conference: after submittals have been provided and before construction has been commenced, a concrete conference shall be coordinated between the Inspector, Engineer of Record, and Contractor.
- C. Lab Testing
  - 1. Compression testing per ACI 318 chapter 5.
  - 2. Shrinkage testing per ASTM C157 for hydraulic structures.
    - a. One shrinkage test is required for the first batch of concrete, and every 500 cubic yards of fresh concrete thereafter.
    - b. Acceptance criteria is 0.035% (0.00035) shrinkage at 28 days.

### **1.06 Project Conditions**

- A. Soil subgrade
  - 1. Prior to setting reinforcing and pouring concrete on soil, the geotechnical engineer of record shall approve of the soil.
- B. Environmental Requirements:
  - 1. Concrete placement shall be limited to temperature ranges per ACI 301.
  - 2. Concrete placement shall be limited to weather conditions per ACI 301.
- C. Wet weather construction. Between the months of October and April, the contractor shall provide a 2" thick minimum mud-mat and sump pit at the bottom of foundation excavations that will be open for more than 72 hours prior to structural concrete placement. In all cases, where rainwater

has saturated the bottom of foundation excavation grade prior to structural concrete placement, the grade shall be recompact prior to concrete placement.

## **PART 2 - PRODUCTS**

### **2.01 General**

A. Except as noted below, all products and materials used in proportioning, mixing, transport, placement, consolidation, curing, and repair shall satisfy ACI 301 and the Construction Drawings.

### **2.02 Materials**

A. Concrete materials

1. Aggregate per ACI 301
2. Cementitious materials per ACI 301
  - a. Cement shall be portland cement.
  - b. Fly ash shall be provided at 15% maximum, 25% maximum of cementitious materials.
3. Admixtures
  - a. Provide as necessary to meet design and workability requirements
  - b. Mixes for hydraulic structures require shrinkage-reducing admixture, such as Eclipse by W.R. Grace.

B. Water shall be potable, and have the following limitations:

1. Chlorides (as Cl) no more than 250 mg/L per EPA method 300.
2. Sulfates (as S04) no more than 250 mg/L per EPA method 300.
3. Total dissolved solids no more than 500 mg/L per EPA method 160.
4. Water quality shall be analyzed by EPA methods. Test results shall be provided to the Engineer of Record for the first batch of concrete, and every 500 cubic yards of fresh concrete thereafter.

C. Curing compounds per ACI 301.

D. Miscellaneous Materials

1. Waterstops are Greenstreak PVC 6" tall flat ribbed.
2. Plugs for formwork wall tie holes are Dayton Sureplug A-58.
3. For formwork ties that are left in place, provide plastic cone spacers for 1.5 inch breakback.

### **2.03 Equipment**

1. Equipment shall conform to ACI 301.

## **PART 3 - EXECUTION**

### **3.01 Preparation**

A. Construction shall not be commenced until the applicable submittals have been approved by the Engineer of Record, and the Inspector has been scheduled.

- B. Reinforcing, embedded items, sleeves, and inserts shall be set and secured prior to fresh concrete placement. Interconnect anchor bolt groups with steel templates.
- C. Construction Joints:
  - 1. Construction joints shall be water-blasted prior to casting fresh concrete against existing concrete.
  - 2. New concrete shall not be placed adjacent to existing concrete younger than 3 days old for hydraulic structures; 2 days otherwise.
- D. Bonding agent shall not be used except where specially required on the Construction Drawings.
- E. Formwork temperature is verified per ACI 301.
- F. Subgrade or hardened concrete to be cast against conforms to ACI 301.

### **3.02 Installation**

- A. Placement of fresh concrete in forms per ACI 301.
- B. Placement of fresh concrete on soil per ACI 301.
- C. Placement of fresh concrete shall be limited to weather constraints per ACI 301.
- D. Depositing fresh concrete per ACI 301 with the following requirements:
  - 1. For hot weather conditions, maximum time from batching to discharge shall not exceed 45 minutes.
  - 2. For normal weather conditions, maximum time from batching to discharge shall not exceed 60 minutes.
  - 3. Time between lift placement shall not exceed 30 minutes for hot weather placement; 60 minutes otherwise.
- E. Consolidate fresh concrete per ACI 301.
- F. Construction joints: Contractor shall not move construction joints from locations shown on Construction Drawings without approval by Engineer of Record.
- G. Finishing formed surfaces
  - 1. Exposed edges shall have 5/8 inch chamfers.
  - 2. Filling Tie Holes:
    - a. No sooner than 14 days after formwork removal, clean and roughen the entire tie hole, and cone taper zone where exists, using an aggressive wire brush.
    - b. Use Dayton Sure Plug A-58 to plug round tie holes on both wall faces.
    - c. Recess plug back 1.0 inches deeper than face of wall or recess cone taper.
    - d. Use Sikatop 123 Plus mortar or approved equal to fill and patch hole.
- H. Finishing Unformed Surfaces:
  - 1. Fresh concrete placement per ACI 301.
  - 2. Finishes definitions per ACI 301 with the following requirements:
    - a. Broom finish coarseness shall not exceed 1/16 inch amplitude and shall be applied perpendicular to the predominate slope of the finished concrete.
    - b. Scratch Finish may also be termed "Roughened Surface" on the Construction Drawings.
  - 3. Finish schedule

- a. Scratch Finish shall be applied to:
  - 1) Construction joints.
  - 2) Surfaces intended to receive bonded cementitious mixtures.
- b. Float Finish shall be applied to:
  - 1) Walks, drives, steps, ramps, and for surfaces intended to receive waterproofing, roofing, insulation, or tiling.
- c. Trowel Finish shall be applied to:
  - 1) Floor intended as interior walking surfaces.
  - 2) Exterior walking surfaces with less than 2 percent slope.
- d. Boom Finish shall be applied to:
  - 1) Exterior walking surfaces with more than 2 percent slope.
  - 2) Elevated slabs, overhangs, bridges where guardrail is required.
- I. Curing shall conform to ACI 301 with the following additional requirements
  - 1. Where a protective coating will be applied to the concrete after curing, liquid (“membrane”) curing compounds shall not be used.
  - 2. Where a liquid curing compound is used, the compound shall be pigmented. Pigmentation shall be removable without special chemicals.
- J. Tolerances per ACI 117.

### **3.03 Protection**

- A. Protection shall be per ACI 301.

### **3.04 Repair**

- A. Repair shall be per ACI 301 with the following requirements:
  - 1. Patching mortar shall be Sikatop 123 Plus or approved equal.
  - 2. Use Sikadur 32 HiMod bonding agent or approved equal.
  - 3. Honeycombs and defects deeper than 38 mm (1.5 inches) shall require approval by Engineer of Record prior to commencing repair work.
  - 4. Cracks wider than 0.5 mm (0.02 inches) for hydraulic structures shall be repaired prior to leak testing.
  - 5. Cracks wider than 1 mm (0.04 inches) shall be repaired.

**\*\*END OF SECTION\*\***

**SECTION 03310  
CAST-IN-PLACE SITEWORK CONCRETE**

**PART 1 - GENERAL**

**1.01 Summary**

- A. The work of this Section includes providing finished cast-in-place concrete, sitework concrete, air placed concrete, including formwork, steel reinforcement, mixing, placing curing, and repairing.
- B. Sitework concrete includes curbs, gutters, catch basins, sidewalks, steps on grade, pavements, fence and guard post embedment, underground duct bank encasement, and all concrete work indicated to be sitework concrete.
- C. Related Sections

<u>Section</u>	<u>Title</u>
Section 03280	Joints in Concrete Pavement
Section 03300	Cast-in-Place Structural Concrete

**1.02 References**

<u>Reference</u>	<u>Title</u>
ACI 117	Standard Tolerances for Concrete Construction and Materials
ACI 301	Specifications for Structural Concrete for Buildings
ACI 304	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 318	Building Code Requirements for Structural Concrete
ASTM C31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

**1.03 Submittals**

- A. Submittals shall be made in compliance with Section 01300-Submittals.
- B. Required submittals shall be provided in accordance with the requirements of 03300-Cast-in-Place Structural Concrete.

**1.04 Quality Control**

- A. Tests on component materials, for the compressive strength of concrete, and for construction tolerances shall be performed in accordance with the requirements of 03300-Cast-in-Place Structural Concrete.
- B. Inspection: Prior to casting concrete or setting reinforcing, the geotechnical Engineer of Record shall observe and approve the subgrade.

## **PART 2 - PRODUCTS**

### **2.01 Concrete Materials**

- A. Concrete component materials, including curing materials and joint materials shall be in accordance with Section 03300-Cast-in-Place Structural Concrete, with the exception that all cast-in-place sitework concrete shall be 6 sack (minimum) and shall have developed a minimum compressive strength of 4,000 pounds per square inch at 28 days.
- B. Abandoned formwork. Except where explicitly shown on the Contract Documents, formwork shall not be left in place.

## **PART 3 - EXECUTION**

### **3.01 General**

- A. Proportioning and mixing, preparation of surfaces for concreting, handling, transporting and placing concrete, finishing and curing concrete surfaces and related procedures shall be performed in accordance with Section 03300-Cast-in-Place Structural Concrete.
- B. Concrete shall not be cast in a line longer than 70 feet in a single day.
- C. Delays between adjacent pours shall be at least 48 hours.
- D. Sitework concrete cast against structural concrete shall be separated by building paper or other barrier to prevent bond, except as explicitly shown on the Drawings.
- E. For non-structural paving, no single placement shall exceed 200 square feet or 14 feet in any direction without a shrinkage contraction joint, unless noted otherwise on the Drawings.

**\*\*END OF SECTION\*\***

# SECTION 03315 GROUT

## PART 1 - GENERAL

### 1.01 Summary

- A. The work of this Section includes providing grout other than that required for masonry work.
- B. The following types of grout are included in the work of this Section:
  - 1. Non-Shrink Grout: This type of grout shall be used wherever grout is required, unless another type is specifically indicated.
  - 2. Cement Grout
  - 3. Epoxy Grout
  - 4. Topping Grout and Concrete Fill
- C. Related Sections

<u>Section</u>	<u>Title</u>
Section 03300	Cast-in-Place Structural Concrete
Section 03310	Cast-in-Place Sitework Concrete

### 1.02 References

- A. Except as otherwise indicated, the current versions of the following apply to the work of this Section:

<u>Reference</u>	<u>Title</u>
CRD-C 621	Corps of Engineers Specification for Non-shrink Grout
ASTM C109	Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in or 50-mm Cube Specimens)
ASTM C531	Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical- Resistant Mortars, Grouts, and Monolithic Surfacing
ASTM C579	Test Methods for Compressive Strength of Chemical-Resistant Mortars and Monolithic Surfacing
ASTM C827	Test Method for Early Volume Change of Cementitious Mixtures
ASTM D696	Test Method for Coefficient of Linear Thermal Expansion of Plastics

### 1.03 Submittals

- A. The following shall be submitted in compliance with Section 01300-Submittals:
  - 1. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, and appropriate uses for each type of non-shrink and epoxy grouts proposed for use in the work.
  - 2. Certified test results verifying the compressive strength, shrinkage, and expansion properties.

### 1.04 Quality Control

- A. Field Tests

1. When a project is used without documentation, compression test specimens will be taken during construction from the first placement of each type of grout, and at intervals thereafter as selected by the Engineer to insure continued compliance with these specifications.
  2. Compression tests and fabrication of specimens for cement grout and non-shrink grout will be performed as specified in ASTM C 109. A set of three specimens will be made for testing at 7 days, 28 days, and each additional time period as appropriate.
  3. Compression tests and fabrication of specimens for epoxy grout will be performed as specified in ASTM C 579, Method B, at intervals during construction as selected by the Owner's representative. A set of three specimens will be made for testing at 7 days, and each earlier time period as appropriate.
- B. The cost of all laboratory tests on grout will be borne by the Owner, but the Contractor shall assist the Owner's Representative in obtaining specimens for testing. However, the Contractor shall be charged for the cost of any additional tests and investigation on work performed which does not meet the specifications. The Contractor shall supply all materials necessary for fabricating the test specimens.

## **PART 2 - PRODUCTS**

### **2.01 Cement Grout**

- A. Cement grout mix design shall satisfy the same requirement as structural concrete, except that cement grout has no large aggregate requirement when the grout thickness is less than 3".

### **2.02 Prepackaged Grouts**

#### **A. Non-Shrink Grout**

1. Non-shrink grout shall be a prepackaged, inorganic, non-gas-liberating, non-metallic, cement-based grout requiring the addition of water. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout indicated herein shall be that recommended by the manufacturer for the particular application.
2. Class A non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi; shall have no shrinkage (0.0 percent) and a maximum 4.0 percent expansion in the plastic state when tested in accordance with ASTM C827; and shall have no shrinkage (0.0 percent) and a maximum of 0.2 percent expansion in the hardened state when tested in accordance with CRD C 621.
3. Class B non-shrink grouts shall have a minimum 28 day compressive strength of 5000 psi and shall meet the requirements of CRD C 621.

#### **B. Application**

1. Class A non-shrink grout shall be used for the repair of all holes and defects in concrete members which are water bearing or in contact with soil or other fill material, grouting under all equipment base plates, and at all locations where grout is specified in the contract documents; except, for those applications for Class B non-shrink grout and epoxy grout indicated herein. Class A non-shrink grout may be used in place of Class B non-shrink grout for all applications.
2. Class B non-shrink grout shall be used for the repair of all holes and defects in concrete members which are not water-bearing and not in contact with soil or other fill material, grouting under all base plates for structural steel members, and grouting railing posts in place.

### **2.03 Topping Grout and Concrete Fill**

- A. Grout for topping of slabs and concrete fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement grout. All materials and procedures specified for concrete in Section 03300-Cast-in-Place Structural Concrete shall apply except as indicated otherwise herein.
- B. Topping grout and concrete fill shall contain a minimum of 564 pound of cement per cubic yard with a maximum water cement ratio of 0.45. Where concrete fill is thicker than 3 inches, structural concrete as indicated in Section 03300-Cast-in-Place Structural Concrete may be used.
- C. Strength: Minimum compressive strength of topping grout and concrete fill at the end of 28 days shall be 4000 psi.

### **2.04 Curing Materials**

- A. Curing materials shall be as indicated in Section 03300-Cast-in-Place Structural Concrete for cement grout and as recommended by the manufacturer of prepackaged grouts.

### **2.05 Consistency**

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is such that the grout is plastic and moldable but will not flow.
- B. Unless otherwise noted on contract dwgs, grout for base plates and equipment leveling shall have flowable, semi-flowable, and packable viscosities. Flowable and semi-flowable consistencies requires formwork.

### **2.06 Measurement of Ingredients**

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurement is not an acceptable method of measurement.

## **PART 3 - EXECUTION**

### **3.01 General**

- A. All surface preparation, curing, and protection of cement grout shall be as required. The finish of the grout surface shall be troweled smooth unless noted otherwise.
- B. Where pre-packaged product is used, the manufacturer's representative shall provide on-site technical assistance upon request.
- C. Base concrete or masonry must have attained its design strength before grout is placed. When bonding to an existing cementitious material is expected, waterblasting or sandblasting to roughen the substrate is required.

### **3.02 Grouting Procedures**

- A. Base Plate Grouting
  1. For base plates, the original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a grout thickness not exceeding 2x the anchor bolt diameter.
  2. After the base plate has been set in position at the proper elevation double nutted on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout. The grout shall be placed so there a no voids between the bottom of the base plate and the concrete.

## B. Topping Grout

1. All mechanical, electrical, and finish work shall be completed prior to placement of topping or concrete fill. The base slab shall be given a roughened textured surface by sandblasting or waterblasting to ensure bonding to the base slab.
2. The minimum thickness of grout topping and concrete fill shall be one inch. Where the finished surface of concrete fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2-inches wide by 1-1/2-inches deep.
3. The base slab shall be thoroughly cleaned and wetted prior to placing topping and fill. No topping concrete shall be placed until the slab is complete free from standing pools or ponds of water. The topping and fill shall be compacted by rolling or tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots which shall be immediately eliminated. When the topping and fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement or mixture of dry cement and sand shall be applied to the surface.

**\*\*END OF SECTION\*\***

## **SECTION 03400 PLANT PRECAST CONCRETE**

### **PART 1 - GENERAL**

#### **1.01 Summary**

- A. The Contractor shall provide and install all pre-cast items as required including all appurtenances necessary to make a complete installation. Electrical pre-cast pullboxes and vaults are excluded from this section.
- B. References
- ACI 318 Building Code Requirements for Structural Concrete
  - ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary
  - ACPA Concrete Pipe Handbook
  - ACPA Design Manual
  - AWS D1.1 Structural Welding Code – Steel
  - AWS D1.4 Structural Welding Code – Reinforcing Steel
  - NPCA QC Manual Quality Control Manual for Precast Concrete Plants
  - PCI Design Handbook

#### **1.02 General Requirements**

- A. Precast concrete units shall be designed and fabricated by an experienced and acceptable precast concrete manufacturer. The manufacturer shall have been regularly and continuously engaged in the manufacture of precast concrete units similar to that indicated in the project specifications or drawings for at least 5 years.

#### **1.03 Submittals**

- A. The following items shall be submitted in compliance with Section 01300-Submittals:
1. Quality control procedures established by the precast manufacturer in accordance with the NPCA Quality Control Manual for Precast Concrete Plants.
  2. Shop Drawings
    - a. The drawings for precast concrete units shall be shop drawings furnished by the precast concrete producer for approval by the owner's representative and engineer of record. These drawings shall demonstrate that the applicable industry design standards have been met. These drawings shall show complete design, exact dimensions, installation, and construction information in such detail as to enable the owner's representative and engineer of record to determine the adequacy of the proposed units for the intended purpose. Deviations from the primary construction documents shall be clouded. The precast concrete units shall be produced in accordance with the approved drawings.
  3. Precast Concrete Unit Data
    - a. The precast concrete producer shall supply data sheets showing conformance to project drawings and requirements and to applicable industry design standards listed in this specification. The precast concrete producer shall provide sufficient information as to demonstrate that such products will perform the intended task.

#### 4. Anchorage, Lifting Inserts and Devices

- a. For anchors, lifting inserts and other devices, the precast concrete producer shall provide product data sheets and proper installation instructions upon request. The precast concrete unit dimensions and safe working load shall be clearly indicated.
- b. Steel anchors exposed to long term weather shall be protected by hot dip galvanization.

#### 5. Accessory Items

- a. For items including, but not limited to sealants, gaskets, pipe entry connectors, steps, racks and other items installed before or after delivery, the precast concrete producer shall include proper installation instructions and relevant product data upon request.

#### B. Design Data

1. Upon request, the precast concrete producer shall supply precast concrete unit design calculations and concrete mix design proportions and appropriate mix design test data. Structural design calculations shall be signed by a licensed professional engineer.

#### C. Test Reports

1. Upon request, the precast concrete producer shall supply copies of material certifications and/or laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolans, ground granulated blast-furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.
2. Upon request, the precast concrete producer shall submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the project conditions. Such tests may include compressive strength, flexural strength, plastic or hardened air content, freeze-thaw durability, abrasion and absorption.
3. Upon request, the precast concrete producer will supply copies of in-plant QA/QC inspection reports.

#### D. Certificates

1. Submit quality control procedures established in accordance with NPCA Quality Control Manual for Precast Concrete Plants or verification of current NPCA Plant Certification.

### 1.04 Design

#### A. Precast Concrete Unit Design

1. Design standard precast concrete units to withstand indicated design load conditions in accordance with applicable industry design standards ACI 318, ACI 350, ACPA Design Manual, PCI MNL-120, and AASHTO. Design must also consider stresses induced during handling, shipping and installation in order to avoid product cracking or other handling damage. Design loads for precast concrete units shall be indicated on the shop drawings. All calculations shall be prepared by a registered engineer.
2. Minimum design loading for soil: As defined by the geotechnical report, but not less than 100 psf / foot depth, with 2'-0" soil surcharge.
3. For buried fluid-containing structures, walls must carry hydrostatic loading without the lateral support of backfill soils. Considerations shall be given to unbalanced loading due to uneven backfill loading; 2'-0" soil height difference between opposing sides shall be a design load case.

#### B. Joints and Sealants

1. Joints and sealants between adjacent units shall be of the type and configuration indicated on shop drawings meeting specified design and performance requirements.

C. Durability and performance requirements

1. Concrete Compressive Strength-

- a. Precast concrete units shall have a 28-day compressive strength (f'c) of 4,000 psi, except where otherwise noted on the approved drawings.

D. Water-Cement Ratio

1. Concrete that will be exposed to freezing and thawing shall contain entrained air and shall have water-cement ratios of 0.45 or less. Concrete which will not be exposed to freezing, but which is required to be watertight, shall have a water-cement ratio of 0.48 or less if the concrete is exposed to fresh water, or 0.45 or less if exposed to brackish water or sea water. For corrosion protection, reinforced concrete exposed to deicer salts, brackish water or seawater shall have a water-cement ratio of 0.42 or less.

E. Air Content

1. The air content of concrete that will be exposed to freezing conditions shall be within the limits given below.

Nominal Maximum Aggregate Size (in)	Air Content %	
	Severe Exposure	Moderate Exposure
3/8	6.0 to 9.0	4.5 to 7.5
1/2	5.5 to 8.5	4.0 to 7.0
3/4	4.5 to 7.5	3.5 to 6.5
1	4.5 to 7.5	3.0 to 6.0
* For specified compressive strengths greater than 5000 psi, air content may be reduced 1%		

**1.05 Quality Assurance**

- A. Precast concrete producer shall demonstrate adherence to the standards set forth in the NPCA Quality Control Manual for Precast Concrete Plants. The precast concrete producer shall be certified by the NPCA Plant Certification Program prior to and during production of the products for this project.

**1.06 1.06 HANDLING, STORAGE AND DELIVERY**

- A. Handling: Precast concrete units shall be handled and transported in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Lifting shall be accomplished with methods or devices intended for this purpose as indicated on shop drawings.
- B. Storage- precast concrete units shall be stored in a manner that will minimize potential damage.
- C. Delivery: Precast concrete units shall be delivered to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite all precast concrete units shall be inspected by the customer or customer's agent for quality and final acceptance.
- D. Acceptable crack dimensions: In addition to the criteria specified under ASTM 1433, the maximum crack length under service conditions is 1/64" wide x 2" long. Precast members with cracks wider and longer are subject to rejection and re-casting at precaster's expense.

## **PART 2 - PRECAST CONCRETE UNITS**

### **2.01 Maintenance Holes and Catch Basins**

- A. Pre-cast Concrete Maintenance Hole Sections: Standard maintenance holes shall be constructed of pre-cast reinforced maintenance hole sections conforming to ASTM C478 and as shown. Pre-cast concrete rings, cones, and flat slabs shall be manufactured by a process that will produce a dense, homogeneous concrete section of first quality. Cement used in all pre-cast sections shall conform to Type V except where noted otherwise.
- B. Catch Basins: Catch basins shall be 3' x 3' x 6" wall thickness with bottom as shown on standard civil details. Catch basins shall have progressive webbed knock-outs to provide maximum flexibility, permitting pipe of any size to be neatly and quickly grouted at the job site. All reinforcing steel shall meet ASTM specifications. Catch basins shall be model U43CP as manufactured by Christy Concrete Products, Inc., Model 1-M as manufactured by Santa Rosa Cast, or equal.
- C. Joint Sealer: Shall meet all the requirements of Federal Specifications SS-S-00210 and shall be Ram-Nek by K.T. Snyder Company, Inc.; Kent-Seal by Hamilton-Kent, or equal.

### **2.02 Concrete Utility Boxes**

- A. Design Loads: Design loads shall consist of live load, dead load, impact load, hydrostatic load, and other loads that may occur unless otherwise indicated on the drawings. Live loads shall be for H-20 per AASHTO Standard Specifications for Highway Bridges-latest edition.
- B. Floors: Unless otherwise indicated on the drawings, pre-cast vaults shall have concrete floors.
- C. Forms: All forms used in placing concrete shall be sufficiently designed and braced to maintain alignment under pressures of concrete placement.
- D. Concrete
  - 1. Aggregates used in the concrete mix either coarse or fine, excluding light-weight aggregates, shall conform to specifications as outlined by ASTM C33.
  - 2. All light-weight aggregates, fine or coarse, shall conform to specifications as outlined by ASTM C330.
  - 3. Both types of aggregates shall be properly graded and free of any deleterious substances so as to produce a homogeneous concrete mix when blended with cement.
- E. Cement: The cement shall be Type II low alkali Portland Cement and shall meet ASTM C150 Type V
- F. Compressive Strength: Sufficient cement content shall be used per batch so as to produce a minimum strength of 4,000 psi at 28 days or other strength by design when required.
- G. Placing: per ACI 301.
- H. Curing: Concrete while still in the forms may be steam cured after an initial set has taken place. Steam temperature shall not exceed 160°F, nor raised from normal ambient temperature at a rate exceeding 40°F per hour. Steam curing shall be considered complete after sufficient time has elapsed to produce adequate strength to withstand any structural strain that may be subjected during the form stripping operation. Additional curing may be applied by means of water spraying or membrane curing compound to reach the ultimate strength requirements.
- I. Reinforcing Steel: ASTM A615 grade 60 or A706.
- J. Preformed Joint Sealant: The joint sealing compound shall be Quik-Seal, a preformed, cold applied, ready to use plastic joint sealing compound as supplied by Quikset Utility Vaults, Santa Ana, California; Ram-Neck by K.T. Snyder Company; or approved equal.

## **PART 3 - EXECUTION**

### **3.01 Pre-Cast Concrete Maintenance Hole and Catch Basin Sections**

- A. Pre-cast concrete sections shall be set so as to be vertical, with sections in true alignment. The joint of the previously set section shall be covered with mortar or joint sealant before the next section is placed. Joints shall be waterproof.

### **3.02 Pre-Cast Vaults**

- A. Pre-cast vaults shall be installed in accordance with the manufacturer's recommendations, unless otherwise required by the drawings. All joints shall be sealed by the use of preformed sealant and mortar or non-shrink grout so as to be water tight.

### **3.03 Connections**

- A. Connections to manufactured, pre-cast items shall be made by casting sections of pipe into the items, using non-shrink grout as shown on the drawings, and/or using an approved resilient connector. All such connections shall be water-tight.

### **3.04 Soil backfill**

- A. Engineered soil backfilling operations next to precast concrete structures shall follow the same requirements as cast-in-place structures. Backfill soils shall be placed in lifts where the highest lift on one side of the structure is not more than 1'-0" higher than the lowest lift.

**\*\*END OF SECTION\*\***

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## SECTION 05120 STRUCTURAL STEEL

### PART 1 - GENERAL

#### 1.01 Summary

A. The work of this section includes providing structural steel and related appurtenances.

#### 1.02 References

<u>Reference</u>	<u>Title</u>
AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC S326	Design, Fabrication and Erection of Structural Steel for Buildings
ASTM A36	Structural Steel
ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Grade B
ASTM A283	Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A307	Carbon Steel Externally Threaded Standard Fasteners, Grade A
ASTM A320	Alloy-Steel Bolting Materials for Low Temperature Service
ASTM A325	High-Strength Bolts for Structural Steel Joints
ASTM A490	Heat-Treated Structural Steel Bolts
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes, Grade B
ASTM A501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A240	Austenitic Stainless Steel, Sheet, Strip, Plate and Flat Bar for Structural Applications, Grade A, Type 304
AWS-B3.0	Welding Procedures and Performance Qualifications
AWS-D1.1	Structural Welding Code – Steel

#### 1.03 Submittals

A. The following shall be submitted in compliance with Section 01330 – Submittal Procedures:

1. Shop drawings, including details, dimensions, details of match markings and all information necessary for fabrication. Drawings shall conform to AISC standards.
2. Welding procedures and welder qualifications.
3. Certificates that steels comply with the indicated standards (“mill certs”).

### PART 2 - PRODUCTS

#### 2.01 Materials

A. Materials for structural steel members and connection shall comply with the Construction Drawings.

## **2.02 Fabrication**

- A. Fabrication shall be in accordance with ANSI/AISC 360 Chapter M and AISC 303. All structural steel welding in off-site fabrication shops shall be continuously inspected by a Certified Special Inspector. The continuous inspection will be waived if the work is done in a shop certified by AISC.

## **PART 3 - EXECUTION**

### **3.01 Installation**

#### **A. General**

1. Structural assemblies and shop and field welding shall meet the requirements of AISC 303.
2. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators.
3. Structural steel completely encased in concrete need not be galvanized or painted and shall have a clean surface for bonding to concrete.

#### **B. Welding**

1. Welding shall be performed by operators who have been qualified by tests as prescribed by AWS D1.1.
2. Continuous seal welds shall be applied on structural steel designed to be exposed to weather or submerged in water or wastewater. Continuous seal welds shall be applied on both sides of structural steel designed to be submerged in water or wastewater.

### **3.02 Corrosion Protections**

- A. Unless otherwise indicated, all structural steel, including that used in the fabrication of process equipment, shall be surface prepared and coated in accordance with Section 09900 – Protective Coating Systems and shall include the following operations:

1. Exterior and interior edges of flame-cut pieces shall be ground smooth.
2. Sharp edges and punched holes shall be ground smooth.
3. Uneven or rough welds shall be ground smooth.

### **3.03 Touch-Up and Repair**

- A. After installation, damaged surfaces of shop-primed structural steel shall be cleaned and touched-up with same material used for shop coat. Prepare surface and recoat per recommendations of Manufacturer's product data sheet.

**\*\*END OF SECTION\*\***

# SECTION 05500 METAL FABRICATIONS

## PART 1 - GENERAL

### 1.01 Summary

A. Miscellaneous metalwork includes the following:

1. Stainless Steel beams, channels and/or angle frames and thresholds with anchors and base plates.
2. Seat Angles, Supports and Brackets.
3. Gratings.
4. Floor and Cover Plates.
5. Concrete Stair Nosings.
6. Aluminum Stairs.
7. Manhole Frames and Covers.
8. Miscellaneous connections, anchors, bolts, clips, spacers, nuts, washers, shapes and inserts, as required.

B. Related Sections

<u>Section</u>	<u>Title</u>
Section 03300	Cast in Place Structural Concrete
Section 03315	Grout
Section 09900	Protective Coating Systems

### 1.02 Codes

A. The work of this Section shall comply with the current edition of the California Building Code.

### 1.03 References

A. Except as otherwise indicated, the current editions of the following apply to the work of this Section.

1. Federal Specifications:

<u>Reference</u>	<u>Title</u>
QQ-F-461 C (1)	Floor Plate, Steel, Rolled
MIL-6-18015	(Ships) Aluminum Planks, (6063-T6)

2. Commercial Standards:

<u>Reference</u>	<u>Title</u>
AISC MO11	Manual of Steel Constructions

ASTM A36	Specification for Structural Steel
ASTM A48	Specification for Gray Iron Castings
ASTM A53	Specification for Pipe, Steel, Black and Hot- Dipped, Zinc-Coated Welded and Seamless
ASTM A123	Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A125	Specification for Steel Springs, Helical, Heat Treated
ASTM A153	Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283	Specification for Low and Intermediate Tensile Strength Carbon Steel Plates, Shapes and Bars
ASTM A307	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile
ASTM A320	Specification for Alloy-Steel Bolting Materials for Low-Temperature Service
ASTM A489	Carbon Steel Eyebolts
ASTM A569	Specification for Steel, Carbon, (0.15 Maximum Percent) Hot Rolled, Sheet and Strip, Commercial Quality
ASTM A575	Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM B98	Specification for Copper-Silicon Alloy Rod, Bar, and Shapes
ASTM B210	Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
ASTM B221	Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B438	Specification for Sintered Bronze Bearings (Oil-Impregnated)
ANSI/AWS D1.1	Structural Welding Code - Steel
NFPA 101	Life Safety Code
NAAMM	Metal Stairs Manual

#### **1.04 Quality Assurance**

A. Fabrication and erection of structural steel and miscellaneous metal work shall be in accordance with the latest edition of the AISC "Specification for the Design, Fabrication and Erection of Steel for Buildings".

#### **1.05 Submittals**

A. The following shall be submitted in compliance with Section 01300-Submittals:

1. Shop drawings of including erection drawings, installation instructions, and layout drawings.

- a. Provide location, type, size and extent of welding and bolted connections and clearly distinguish between shop and field connections.
- b. Coordinate shop drawings to insure proper mating of assemblies.
2. Anchorage details and structural design calculations. Structural drawings will be sealed by a structural engineer licensed in the State of California.
3. Product data for all materials and components.
4. Test Reports.
  - a. Furnish certified physical and chemical mill test reports for material used for major structural members. Perform all tests in accordance with applicable ASTM Standards.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Products of the type or model (if any) indicated shall be manufactured by one of the following (or equal):
  1. Aluminum Grating:
    - a. IKG Borden
    - b. Seidelhuber
  2. Steel Gratings:
    - a. Irving Type IWA
    - b. Gary Type GW
  3. Floor and Cover Plates:
    - a. Alcoa C-102 Aluminum Tread Plate
    - b. Reynolds Diamond Tread Plate
  4. Safety Stair Nosings:
    - a. Wooster Products, Incorporated Alumogrit, Type 101
    - b. American Abrasive Metals Company Alumalum, Style A
    - c. Safe-T-Metal Company Incorporated Style AX

### **2.02 Materials**

- A. Materials: Except as otherwise indicated, products fabricated of structural steel shapes, plates and bars shall comply with the requirements of ASTM A 36 or ASTM A283.
- B. Stainless Steel: Stainless steel metalwork and bolts shall be of Type 316 or 316L stainless steel for all corrosive environments.
  1. Rolled shapes, plates, and bars shall conform to the latest edition of the AISC "Manual of Steel Construction" and shall also conform to current ASTM Designation A 36.
  2. Use stainless steel alloy types as follows which conform to ASTM A-167 and ASTM A-276:
    - a. Stainless steel plates and bars shall be Type 304 or Type 316 unless otherwise noted.
    - b. Stainless steel anchor bolts shall be Type 316 unless otherwise shown or specified.

- c. Stainless Steel structural Tanks shall be Type 304.
- d. Stainless steel bolts, nuts and washers shall be Type 304 or 316 where connecting or bearing on aluminum.

## **2.03 Fabrication**

### **A. Corrosion Protection:**

- 1. Miscellaneous steel metalwork shall be hot-dip galvanized after fabrication except as otherwise indicated.
- 2. Miscellaneous metalwork of fabricated steel, which will be used in a corrosive environment or will be submerged in wastewater, shall be coated in accordance with Section 09900 - Protective Coating Systems.

### **B. Welding:**

- 1. Welding shall be by the metal-arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" and supplemented by other standards of the AWS. Qualification of welders shall be in accordance with the AWS Standards.
- 2. In assembly and during welding, the component parts shall be adequately clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS Code.
- 3. Upon completion of welding, weld splatter, flux, slag, and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance, with uniform weld contours and dimensions. Sharp corners of material that is to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.
- 4. Stainless Steel Electrodes. Perform welding of stainless steel with electrodes and techniques as contained in pertinent AWS A5 Series Specification.

### **C. Galvanizing:**

- 1. Where galvanizing is indicated, structural steel plates, shapes, bars and fabricated assemblies shall be thoroughly cleaned of rust and scale and shall be galvanized in accordance with the requirements of ASTM A 123.
- 2. Any galvanized part that becomes warped during the galvanizing operation shall be straightened.
- 3. Bolts, anchor bolts, nuts and similar threaded fasteners, after being properly cleaned, shall be galvanized in accordance with the requirements of ASTM A 153.

## **2.04 Bolts**

### **A. Bolt Requirements: Bolts shall comply with the following:**

- 1. The nuts shall be capable of developing the full strength of the bolts.
  - a. Threads shall be Coarse Thread Series conforming to the requirements of the American Standard for Screw Threads.
  - b. Bolts and cap screws shall have hexagon heads and nuts shall be Heavy Hexagon Series.
- 2. The length of all bolts shall be such that after joints are made up, each bolt shall extend through the entire nut, but in no case more than 3 threads beyond the nut.

### **B. Standard Service Bolts (Not Buried, Corrosive or Submerged):**

1. Except where otherwise indicated, bolts and nuts shall be steel and shall be hot-dip galvanized after fabrication.
2. Threads on galvanized bolts and nuts shall be formed with suitable taps and dies such that they retain their normal clearance after hot-dip galvanizing.
3. Except as otherwise indicated herein, steel for bolts, anchor bolts and cap screws shall be in accordance with the requirements of ASTM A 307 Grade A or B, or threaded parts of ASTM A 36.

C. Buried, Corrosive or Submerged Bolts:

1. Unless otherwise indicated, bolts, anchor bolts, nuts and washers, which are buried, submerged, or below the top of the wall inside any hydraulic structure or as indicated on the Drawings shall be of Type 316 stainless steel.

D. Unless otherwise indicated, eyebolts shall conform to ASTM A 489.

## 2.05 Seat Angles, Supports and Brackets

- A. Seat angles over slide gate guides shall be welded to the guides.
- B. Seat angles for supports for floor plates, clips for precast panels and brackets for piping shall be steel, hot-dip galvanized after fabrication unless otherwise indicated.
- C. For angles used in corrosive, below top of wall inside any hydraulic structure or submerged environments material shall be Type 316L stainless steel or aluminum.
- D. Seat angles for aluminum grating shall be aluminum unless otherwise noted.
- E. Seat angles for steel grating shall be hot-dipped galvanized steel.

## 2.06 Aluminum Gratings

- A. Grating shall be fabricated in accordance with the details shown and shall be designed for a live load of 150 pounds per square foot with deflection not exceeding 1/360 of the span unless otherwise noted.
- B. Minimum grating height: 1-1/2-inches.
- C. Both bearing bars and cross bars shall be continuous.
- D. Grating shall be serrated to produce a nonskid walking surface.
- E. Openings shall be banded with bars having the same dimensions as the bearing bars.
  1. Openings 6-inch and larger: layout opening centerline at edge of two adjacent grating sections.
  2. Openings 6-inch and smaller: layout opening at edge of single grating section.
- F. Perimeter edges shall be banded with bars flush at the top surface of the grating and 1/4 inch clear of the bottom surface.
  1. Bars terminating against edge bars shall be welded to the edge bars when welded construction is used.
  2. When crimped or swaged construction is used, bars at edges shall protrude a maximum of 1/16 inch and shall be peened or ground to a smooth surface.
- G. No single piece of grating shall weigh more than 50 pounds unless otherwise indicated.
- H. Rough weld beads and sharp metal edges on gratings and plates shall be ground smooth. Welds exposed to view shall be uniform and neat.

- I. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise indicated. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.
- J. Aluminum grating bearing bars and aluminum floor plates and cover plates shall be of alloy 6061-T6 conforming to ASTM B221.
- K. Aluminum grating cross bars shall be of an alloy conforming to either ASTM B221 (extrusions) or B210 (drawn).
- L. Bearing bars shall be punched to receive the cross bars.
  - 1. After insertion in the bearing bars, cross bars shall be deformed by a hydraulic press or similar means to permanently lock the bars into the bearing bar openings.
  - 2. Fabrication methods employing bending or notching of bearing or cross bars will not be permitted.

### **2.07 Floor and Cover Plates:**

- A. Design Criteria: As indicated on the Drawings.
- B. Plates shall be set flush with surrounding floor.
- C. No single piece of floor and cover plate shall weigh more than 80 pounds unless specifically detailed otherwise.
- D. Plates shall be aluminum unless otherwise indicated.
- E. The size of the openings shall be as shown on the plans.
- F. Steel Checker plates, if indicated, shall be hot dip galvanized after fabrication.

### **2.08 Aluminum Stairs**

- A. Unless otherwise indicated, stairs shall be aluminum.
- B. Aluminum structural shapes shall be alloy 6061-T6 meeting the ASTM specifications included in Aluminum Association current Construction Manual Series.
- C. Stairs shown are schematic. The Contractor shall design and construct the stairs, support system, footings and all necessary appurtenances.
- D. Fasteners shall be Type 304 or 316 stainless steel.

### **2.09 Manhole Frames and Covers**

- A. Materials:
  - 1. Cast iron, ASTM A48, Class 30.
  - 2. Covers shall be gasketed to provide a seal between the frame and cover.
- B. Fabrication:
  - 1. Castings shall be clean and free from blow or sand holes, or defects of any kind.
  - 2. Castings shall meet the requirements of local County/City/Owner standards.

## **PART 3 - EXECUTION**

### **3.01 General**

- A. Fabrication and Erection: Except as otherwise indicated, the fabrication and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction."
- B. General:
1. Fieldwork, including cutting and threading, shall not be permitted on galvanized items.
  2. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators.
  3. Grouting of anchor bolts with non-shrink or epoxy grouts, where indicated, shall be in accordance with Section 03315 - Grout.
  4. Drilling of bolts or enlargement of holes to correct misalignment will not be allowed.
  5. Metalwork to be embedded in concrete shall be placed accurately and held in correct position while the concrete is placed or, if indicated, recesses or blockouts shall be formed in the concrete.
    - a. The surfaces of metalwork in contact with or embedded in concrete shall be thoroughly cleaned.
    - b. Recesses may be neatly cored in the concrete after it has attained its design strength and the metalwork grouted in place.
    - c. Embedments shall comply with Section 03300 - Cast-in-Place Structural Concrete.
  6. Holes shall be punched 1/16-inch larger than the nominal size of the bolts, unless otherwise indicated. Whenever needed, because of the thickness of the metal, holes shall be subpunched and reamed or shall be drilled.
  7. Fabrication including cutting, drilling, punching, threading and tapping required for miscellaneous metal or adjacent work shall be performed prior to hot-dip galvanizing.
- C. Aluminum Jointing and Connections
1. Accurately cope and join connecting members to a hair-line fit unless otherwise detailed or approved. Except at required offsets, construct exposed surfaces with flush joints.
  2. Mechanically Assembled Joints. Provide concealed reinforcing shapes and accessories, of type and design to equal or exceed the strength of the strongest member connected. Use aluminum, non-magnetic stainless steel, or zinc-coated steel that is carefully isolated as specified hereinafter.
  3. Welded Joints. Perform welding by inert gas shielded arc method, or fluxless resistance welding method in accordance with parent metal manufacturer's published recommendations and requirements herein. Unless otherwise shown or approved, place welds on concealed surfaces and take precautions to minimize heat discoloration of exposed surfaces. Make welds of size and type to develop at least twice the strength of the connected members, except where more stringent requirements are shown, specified, or are standard with item manufacturer. Pre-heat and anneal as necessary to relieve residual stresses. Finish exposed welds to match adjoining surfaces.
    - a. Welding Assemblies To Be Anodized. Construct members so faying surfaces are free rinsing and do not trap anodizing solutions. Where weld metal is exposed, use filler rods of

composition recommended by manufacturer or member to be welded to provide uniform color match between metals.

- b. Assemblies Anodized Prior to Welding. Clean areas of fusion free of anodic film prior to welding. Parts may be masked during anodizing, or sanded clean in weld area. Heat crazing or discoloring of anodic film on exposed surfaces is not acceptable.
  - c. Rejected Welds. Repair by re-welding only. Remove defective welds by chipping or grinding. Gas cutting is prohibited.
4. Fasteners. Unless shown, specified, or approved, do not use screws or other fasteners on exposed surfaces. Where used and feasible, provide countersunk exposed fasteners with Phillips type flat heads. On clear anodized work, use aluminum or non-magnetic stainless steel. On color anodized work, use aluminum alloy fasteners finished to match adjoining surfaces. Provide fasteners of suitable sizes, located and spaced to securely connect work and resist imposed loads, and as may be required under other Sections, all subject to approval.

#### D. Stainless Steel Fabrication and Installation Requirements

1. Standards. Metals shall be thoroughly cleaned before being fabricated. Finished members shall be free of twists, bends or open joints, and shall present a neat workmanlike appearance when completed. Steel work shall conform to the best practices set forth in the "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction, latest edition.
2. Welding. All welding shall be done in accordance with the "Structural Welding Code-Steel", AWS D1.1 and current revisions. Where Gas Metal Arc Welding (GMAW) process is used, however, the short circuited mode shall be used only for light gage material (12 gage and lighter).
3. General Fabrication and Installation. Using specified new stock of standard sizes specified or detailed, fabricate in shop producing high grade metal work. Form and fabricate to meet required conditions. Include clips, straps, bolts, screws, and other fastenings necessary to secure the work. Conform applicable work to latest edition of Referenced Standards. Accurately make and tightly fit joining and intersections in true planes with adequate secure fastenings. All metal work shall be erected plumb, true on line and in its designated location. Field welds on exposed surface shall be ground and finished smooth. Connections shall be bolted or welded as indicated on drawings. After installation, all work shall be left in a neat and clean condition, ready for field painting or coating.
  - a. Compliance with Safety Requirements. Dimensions required for the fabrication and installation of handrails, ladders, grating, plate, pipe hangers and etc. which are not shown on the drawings, shall conform to the applicable requirements of the manufacturer's local OSHA Occupational Safety and Health Standards. It is on the client/engineer to verify suitability with project specific OSHA requirements and illustrate those to the manufacturer.
  - b. Do not field cut or alter structural integrity of members without explicit approval of Engineer.
  - c. Grout under base plates where suitable. Use stainless steel shims where grout is not suitable.
  - d. A liberal coating of LOC-TITE, or approved equal shall be applied to the threads before screwing on nuts when required.
  - e. In anchoring equipment bases subject to vibration, two nuts shall be used, one serving as a lock nut, unless other locking mechanical devices are employed.

### **3.02 Installation of Seat Angles, Supports and Guides**

- A. Seat angles shall be set flush with the floor. Aluminum material in contact with concrete shall be coated per specification Section 09900 - Protective coating systems.

### **3.03 Installation of Grating, Floor and Cover Plates**

- A. Grating, floor and cover plates shall be field measured for proper cutouts and proper sizes.
- B. Maximum 1/8-inch clearance between ends of grating and at inside face of vertical leg of edge angles.
- C. Installed grating shall not slide off or out of support.
- D. Top surfaces of adjacent grating sections shall be flush, in the same plane.

### **3.04 Installation of Safety Stair Nosings**

- A. Unless otherwise indicated, safety stair nosings shall be installed on all concrete stairs, including top tread on upper concrete slab.
  - 1. Center nosing on step with approximately 3-inches from each stair edge.
  - 2. Nosings shall be secured to concrete with suitable anchors at 15 inches on centers and not more than 4 inches from the ends.
- B. Coat aluminum surfaces in contact with concrete per Section 09900 - Protective Coating Systems.
- C. Rubber tape, 1/8-inch thick, shall be provided at both ends and cut to fit shape of nosing prior to concrete placement.

### **3.05 Aluminum Stairs**

- A. Fabrication: Stairs shall be fabricated in accordance with the Aluminum Association Standards and manufacturer's recommendations.
  - 1. Sheared edges exposed in finished work shall be ground smooth.
- B. Welding: Stairs shall be welded with Gas Metal Arc (MIG) or Gas Tungsten Arc (TIG) processes in accordance with the manufacturer's written instructions and with recommendations of the American Welding Society contained in the Welding Handbook, as last revised.
  - 1. All exposed aluminum welds shall be ground smooth.
- C. Installation: Erection shall be in accordance with the Aluminum Association.
  - 1. Mill markings shall not be removed from concealed surfaces.
  - 2. Inked or painted identification marks on exposed surfaces not otherwise coated shall be removed after installed material has been inspected and approved.
  - 3. Stairs shall be fitted accurately and field measured where necessary.

### **3.06 Installation of Manhole Frames and Covers**

- A. Manhole frames and covers shall be set flush with the surrounding surfaces unless otherwise specified.

### **3.07 Aluminum Finishing**

- A. Perform anodized finishing in plant of finisher approved and licensed by parent metal manufacturer. Exposed Work shall be free of finger marks, stains, scratches and other undesirable marks or flaws, and gripper or rack marks. Perform finishing after fabrication and

forming operations are completed. Finishes shall be uniform on exposed surfaces including edges of members. Aluminum shall not be painted.

- B. Finishes are defined by and shall conform to Aluminum Association "Standards for "Anodized Architectural Aluminum" and "Designation System for Aluminum Finishes".
- C. Pretreatments. Clean per AA-C12 prior to pre-treatments.
  - 1. As Fabricated AA-M12, mill finish.
  - 2. Etched AA-C21, C22 or C23, chemical match as required to produce selected texture matching approved samples.
  - 3. Directional Textured AA-M31, fine satin finish.
  - 4. Buffed AA-M21, smooth specular.
- D. Clear Anodized Finishes. Natural aluminum color.
  - 1. Class I. AA-A41, Architectural Class I clear anodized finish having 0.7 mil and greater coating thickness, 27 mg/sq inch coating weight, and 38 g/cu.in. apparent density as minimums. For exterior and interior clear anodized work unless otherwise specified.
- E. Color Anodized Finishes.
  - 1. Type. AA-A42, Architectural Class I integral color coating having 0.7 mil and greater coating thickness, 32 mg/sq inch coating weight, and 38 g/cu.in. apparent density as minimums.
  - 2. Color. Kawneer's "Permanodic" Dark Bronze or equivalent and matching colored anodic hardcoat of Kaiser's "Kalcolor", Alcoa's "Duranodic", or Northrop Architectural System's "Colormodic" finishes, as approved. This paragraph specifies required color only, not alloys to be used. Refer to Paragraph "Coordination of Materials" hereinbefore. Perform color anodic finishing in strict accordance with procedures established by parent aluminum manufacturer whose finishing system is used, and such finishing shall be performed by finisher licensed by said parent aluminum manufacturer. Provide written certification of compliance with each.
- F. Usages. Unless otherwise specified within respective trade Sections, provide the following finishes:
  - 1. Aluminum Rail and Railing Assemblies. Uniformly finished with clear anodic finish AA-C21A4I consisting of fine matte chemical etched texture and Architectural Class I clear anodic finish.
  - 2. Aluminum, Gratings, Ladders and Checkerplate Assemblies. Uncoated and as fabricated clear aluminum finish.

**\*\* END OF SECTION \*\***

## **SECTION 05501 ANCHOR BOLTS AND ANCHORING DEVICES**

### **PART 1 - GENERAL**

#### **1.01 Summary**

- A. Anchor bolts, concrete anchors and other anchoring devices for mechanical and electrical equipment.
- B. Related Sections
  - a. Section 01610 – Seismic Anchorage and Bracing

#### **1.02 Design Requirements**

- A. Comply with the current edition of the California Building Code (CBC).
- B. Where specified in the individual equipment sections or in the specifications, provide structural calculations and supporting drawings including details stamped and signed by a professional civil or structural engineer registered in the State of California. Submit with equipment submittal.
- C. Comply with Section 01300.

#### **1.03 Submittals**

- A. Include the following items:
  - 1. Product Data: Manufacturer's data for nuts, bolts, concrete anchors, chemical anchors and other fasteners.
  - 2. Catalog data and ICC-ES reports for each type of anchor bolt.

#### **1.04 Quality Assurance**

- A. Special inspection for the installation of chemical anchors shall be made by the Owner in accordance with the CBC.
- B. Do not use expansion-type concrete anchors or adhesive-type anchors set in holes drilled in the concrete as a substitution for cast-in-place anchor bolts.

### **PART 2 - PRODUCTS**

#### **2.01 Materials**

- A. Unless otherwise specified or indicated on the Drawings, materials of construction for anchoring devices shall conform to the following:
  - 1. Anchor bolts and other anchoring devices, nuts and washers installed indoors: Type 316 stainless steel.
  - 2. Anchor bolts and other anchoring devices, nuts and washers installed outdoors or in locations exposed to wastewater: Type 316 stainless steel.
    - a. Locations exposed to wastewater ~~includes:~~
    - b. Below tops of walls of water-containing structures.

- c. Underside of roof, slab or walkways of enclosed water-containing structures.
- d. Dry side of walls on water-containing structures.

## **2.02 Anchoring Devices**

### **A. Cast-in-Place Anchor Bolts**

- 1. Bolt: Conform to ASTM A320, Type 316 stainless steel
- 2. Minimum Length of Bolt: Per design calculations or per Drawings
- 3. Head Type: Hexagonal headed bolt
- 4. Nuts and washers: ASTM A194, Type 316 stainless steel

### **B. Concrete Anchors**

- 1. Drilled in place wedge-type anchors with integral threaded studs. Anchors shall be suitable for cracked concrete.
- 2. Manufacturers: One of the following or equal:
  - a. ITW Ramset/Redhead, Trubolt Wedge.
  - b. Hilti Kwikbolt TZ.
- 3. Material: Anchor material shall be 316 stainless steel.

### **C. Studs**

- 1. ASTM A108 with 50,000 pounds per square inch minimum yield strength, and 60,000 pounds per square inch minimum tensile strength.
- 2. Manufacturers: One of the following or equal:
  - a. Nelson Stud Welding Company, S3L Shear Connectors or H4L Concrete Anchors.
  - b. Stud Welding Products, Headed Concrete Anchors and Shear Connectors or Concrete Anchors.

### **D. Chemical Anchors**

- 1. Do not use in overhead applications, in chlorine gas environments, or where anchor may be exposed to machine or diesel oils.
- 2. Materials: Type 316 stainless steel all-thread rod with vinyl ester resin adhesive.
  - a. Stainless steel all-thread rod: Conform with ASTM F593.
- 3. Manufacturers: One of the following or equal:
  - a. Hilti RE HY-200 System.
  - b. ITW Redhead Epcon G5.
- 4. Anchors shall be suitable for cracked concrete.

## **PART 3 - EXECUTION**

### **3.01 General Anchoring Requirement**

- A. Install anchor bolts, concrete anchors and other anchoring devices with at least 2 threads projecting beyond the nut, but no more than 1/2-inch projecting beyond the nut.

- B. Prior to installing nuts, coat threads of stainless steel bolts with material to prevent galling of threads.
  - 1. Manufacturers: One of the following or equal:
    - a. Never Seez Compound Corporation, Never-Seez.
    - b. Oil Research, Inc., WLR No. 111.
- C. Tighten nuts on anchor bolts, concrete anchors and other anchoring devices to the "snug-tight" condition, defined as tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary wrench.

### **3.02 Cast-in-Place Anchor Bolts**

- A. Accurately place anchor bolts to be embedded in concrete within the formwork and perpendicular to surface from which they will project. Secure in correct position while concrete is placed.
- B. Do not allow anchor bolts to touch reinforcing steel.
  - 1. Where anchor bolts are within 1/4 inch of reinforcing steel, isolate with a minimum of 4 wraps of 10 mil polyvinyl chloride tape in area adjacent to reinforcing steel.
- C. In anchoring machinery bases subject to heavy vibration, use 2 nuts, with 1 serving as a locknut.
- D. Where bolts are indicated on the Drawings for future use, first coat thoroughly with non-oxidizing wax, then turn nuts down full depth of thread and neatly wrap exposed thread with waterproof polyvinyl tape.
- E. Where indicated on the Drawings, set anchor bolts in metal sleeves having inside diameter approximately 2 inches greater than the bolt diameter and a minimum of 10 bolt diameters deep.
- F. Fill sleeves with grout when equipment is grouted in place.
- G. Anchor bolts may be cast in concrete in lieu of using concrete anchors.

### **3.03 Concrete Anchors and Chemical Anchors**

- A. Do not use concrete anchors or chemical anchors in lieu of anchor bolts.
- B. Drill holes using concrete drill bits and impact type drill motors.
- C. Hole diameter: in accordance with the manufacturer's recommendations.
- D. Clean drilled hole using compressed air to dislodge and remove drilling dust.
- E. Accurately locate concrete anchors and set perpendicular to surfaces from which they will project.
- F. Minimum embedment lengths shall be per manufacturer safe load tables.

**\*\* END OF SECTION \*\***

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## SECTION 05520 ALUMINUM HANDRAILING

### PART 1 - GENERAL

#### 1.01 Summary

A. This Section specifies pre-engineered, prefabricated anodized aluminum handrails.

#### 1.02 Quality Assurance

A. General: Handrailing and guardrailing shall meet the requirements of the standards of the Occupational Safety and Health Administration (Title 8), the Division of Industrial Safety of the State of California (Title 24), and the current state building code.

B. References

<u>Reference</u>	<u>Title</u>
ASTM A320	Alloy-Steel Bolting Materials for Low Temperature Service
ASTM B241	Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

#### 1.03 Submittals

A. The following shall be submitted in compliance with Section 01300-Submittals:

1. Materials, finishes, connecting and joining methods, installation details.
2. Shop drawings, including details, dimensions, details of match markings and all information necessary for fabrication.
3. Engineering calculations for railings, handrail brackets, brackets, support flanges and fasteners or anchors, stamped and sealed by a registered engineer.

#### 1.04 Delivery, Storage and Handling

- A. Manufactured materials shall be packaged and shipped in individual plastic film to protect the anodized surface and placed in containers constructed for normal shipping, handling and storage.
- B. The containers shall be provided adequate protection from the equipment and stored until time for installation.

### PART 2 - PRODUCTS

#### 2.01 General

A. Handrailing Systems shall be Manufactured by:

1. TUFrail as manufactured by Thompson Fabricating;
2. Connectorail as manufactured by Julius Blum and Company, Inc.;
3. WesRail as manufactured by Moultrie Manufacturing Co., Moultrie, GA;
4. C-V Pipe Rail as manufactured by CraneVeyor Corporation,
5. or equal.

B. Except as otherwise shown, pipe railings shall be 1-1/2-nominal, schedule 40, 1.90-inch actual diameter.

- C. Posts shall be secured to concrete and metal structures as indicated on the drawings. Posts shall be either set in concrete or side mounted. Post set in concrete shall be set into preformed holes and secured in place with non-shrink grout.
- D. Toe plates (“kick plates”) are required at base of posts.

## **2.02 Materials**

- A. Materials for handrailing shall be as follows:

Pipe railing and posts	Aluminum ASTM B241, Alloy 6061-T6 or 6063-T6
Bolts, nuts, washers	Stainless Steel, Type 316

- B. Finishes: Aluminum railing components shall have a clear satin anodized Architectural Class I finish of minimum 0.7 mil thickness. Rails, posts, stanchions, and specials shall be fabricated from cylindrical sections.

## **PART 3 - EXECUTION**

### **3.01 Fabrication**

- A. Posts shall be continuous from mounting surface to top rail and attached whenever possible, to a minimum of three posts. Bottom and intermediate rails shall be un-spliced lengths between posts.
- B. Pipe cuts shall be clean, straight, square and accurate for minimum joint gap. Work shall be done in conformance with the handrail manufacturer's instructions. Work shall be free from blemishes, defects, and misfits of any type that can affect durability, strength or appearance.
- C. Holes shall be punched 1/16 inch larger than the nominal size of the bolts, unless otherwise specified. Pieces with mismatched holes shall be replaced. No drifting of bolts nor enlargement of holes will be allowed to correct misalignment.

### **3.02 Installation**

- A. Assembly installation of handrail system shall be performed in accordance with manufacturer's written recommendations for installation and the details.
- B. Measurements shall be verified at the site.
- C. Expansion joints shall be provided for 0.20-inch expansion and contraction per 24 feet of railing. The expansion shall be placed within 8 inches of post and should also coincide with the expansion joints and shrinkage contraction joints in the structural walls and floors.
- D. Provisions should be made for exterior installations to drain water from the railing system. Provisions should be made for interior installation subject to high humidity. Weep holes a minimum of 15/64" in diameter shall be drilled at all posts at low points.
- E. Dissimilar metals shall be protected from galvanic corrosion by means of pressure tapes, coatings or isolators. Aluminum in contact with concrete or grout shall be protected with a heavy coat of bituminous paint or urethane.
- F. When posts set in grout, top of grout or sealant shall be shaped to shed water away from embedment.

**\*\*END OF SECTION\*\***

## **SECTION 05910 HOT-DIP ZINC COATING**

### **PART 1 - GENERAL**

#### **1.01 Summary**

A. This Section specifies hot-dip zinc coating. Unless otherwise specified, steel items not fully encased in a building envelope shall be hot-dip zinc coated. Also termed hot dip galvanized.

#### **1.02 References**

<u>Reference</u>	<u>Title</u>
ASTM A90	Standard Test Methods for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM A123	Zinc Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip
ASTM A153	Zinc Coating on Iron and Steel Hardware
ASTM A384	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A385	Providing High Quality Zinc Coatings on Assembled Products
ASTM A386	Zinc Coating on Assembled Steel Products
MILSPEC	Paint, High Zinc Dust Content, Galvanizing
DOD-P-21035	Repair

### **PART 2 - PRODUCTS**

#### **2.01 Materials**

A. The coating material shall be as specified in ASTM A153 or ASTM A123.

### **PART 3 - EXECUTION**

#### **3.01 Galvanizing**

A. The thickness, chemistry, and all other engineering properties of galvanizing shall be defined by ASTM A153 and ASTM A123.

#### **3.02 Field Repairs**

A. Where zinc coating has been damaged, substrate surface shall be cleaned and repaired with zinc dust-zinc oxide coating in accordance with MILSPEC DOD-P-21035.

B. Field repair of zinc coated surfaces, including Unistruts shall be accomplished with the following products:

1. Z.R.C., as manufactured by Z.R.C. Chemical Products Co.;
2. Galvicon as manufactured by Galvicon Co.;
3. or equal.

### **3.03 Post-Galvanizing Coating**

- A. When paint is required over a hot-dip galvanized coating, the galvanized surface requires special preparation. Chemical or abrasive methods may be used, with care exercised to not remove too much of the galvanized coating.

**\*\*END OF SECTION\*\***

## SECTION 07900 SEALANTS & CAULKING

### PART 1 - GENERAL

#### 1.01 Summary

A. Section Includes:

1. Cleaning and preparation of joint surfaces;
2. Sealant and backing materials;
3. Sealant backup;
4. Vapor Barriers;
5. And associated materials.

#### 1.02 References

<u>Reference</u>	<u>Title</u>
ASTM C834	Specification for Latex Sealing Compounds
ASTM D1056	Flexible Cellular Materials -- Sponge or Expanded Rubber
ASTM C920	Standard Specifications for Elastomeric Sealers

#### 1.03 Submittals

A. Product Data and Samples

1. Submit product data and samples in accordance with Section 01300-Submittals.
2. Submit manufacturer's surface preparation and installation instructions.
3. Submit samples of sealant colors.

#### 1.04 Warranty

- A. Provide two year warranty for materials and workmanship against leakage.
- B. Exterior work that does not remain watertight and all work which does not retain all properties inherent in the product will be considered faulty.

### PART 2 - PRODUCTS

#### 2.01 Manufacturers

- A. Manufacturers listed below are approved with regards to their specific products.
- B. Items of same function and performance are acceptable in accordance with Section 01600-Materials and Equipment Substitutions.
- C. Stipulations:
1. The sealant or caulking material and the corresponding cleaner, joint filler or bond breaker, and primer shall all be products of, or certified as compatible by, the approved manufacturer of the sealant or caulking material.
  2. All products shall be suitable and recommended by the manufacturer for the application.

D. Installer qualifications:

1. The installer shall have a minimum of 5 years experience in applying sealant systems and shall have a successful record of joint and sealant application in similar work.

E. Application of sealants:

1. Apply sealants in accordance with the manufacturer's written instructions. Check expiration date and shelf life of all products before use. Do not use expired products.

**2.02 Sealant Materials**

A. Two-Part Urethane: ASTM C920, Type M, Self-Leveling, Class 25

1. Bostik Construction Products: Chem-Calk 550
2. Tremco: Vulkem 245
3. Pecora Corporation: Dynatrol II - SG
4. BASF Sonneborn: Isolastic SL-2, Paving joint sealant
5. Sika Corporation: Sikaflex 2c SL

B. Two-Part Urethane: ASTM C920, Type M, Non-Sag

1. Bostik Construction Products: Chem-Calk 505
2. Tremco: Vulkem 227
3. Pecora Corporation: Dynatrol II
4. BASF Sonneborn: Sonolastic NP-2
5. Sika Corporation: Sikaflex 2c NS

C. One-Part Urethane: ASTM C920, Type S, Non-Sag, Class 25

1. Bostik Construction Products: Chem-Calk 900
2. Tremco: Vulkem 116
3. Pecora Corporation: Dynatrol I-XL
4. BASF Sonneborn: Sonolastic NP-1
5. Sika Corporation: Sikaflex 1a

D. One-Part Silicone: ASTM C920, Type S, Non-Sag, Class 25

1. Bostik Construction Products: Chem-Calk 1200
2. Dow-Corning Corporation: 999-A
3. Pecora Corporation: 860
4. General Electric Company: SCS 1000
5. BASF Sonneborn: Ommiplus

E. Latex-Acrylic Sealant: ASTM C834, Non-Sag, Class 25

1. Pecora Corporation: AC-20
2. Tremco: Tremflex 834
3. BASF Sonneborn: Sonolac
4. Bostik: Chem-Calk 600

F. Immersed Service Sealant

1. Sika Corporation: Sikaflex 2c
2. Tremco: Vulkem 227
3. Polymeric Systems, Inc.: PSI 270
4. Pacific Polymers International: Elasto-Thane 227 R

G. Foam Sealer:

1. Emseal Corporation "Grayflex" self adhesive polyurethane foam.
2. Or Equal

H. Caulking Compound:

1. Gibson-Homans #2345,
2. Adco Products "Adcoseal AL-800",
3. Sonneborn Building Products "Sonolac",
4. Dap, Inc., "Acrylic Latex".

I. Sealant or caulking color will vary with application point as directed by the Engineer.

**2.03 Accessories**

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.

B. Joint Cleaner:

1. Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Joint Filler:

1. Backing Rods: ASTM D1056; round, closed cell foam rod; oversized 30 to 50 percent; Grey Flex manufactured by Emseal.
2. Secondary Joint Sealer: Neoprene, butyl, EPDM, or silicone tubing, non-absorbent to water and gas, capable of remaining resilient at -26 degrees Fahrenheit. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.

D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

**PART 3 - EXECUTION**

**3.01 Examination**

- A. Verify joint dimensions, physical, and environmental conditions are acceptable to receive work of this Section.
- B. Beginning of installation means acceptance.

**3.02 Preparation**

- A. Clean, prepare, and size joints in accordance with manufacturer's instructions. Remove any loose materials and other foreign matter which might impair adhesion of sealant.
- B. Joints and spaces to be filled shall be clean, dry and free of dust, loose mortar and other foreign materials.

- C. Verify that joint shaping materials and release tapes are compatible with sealant.
- D. Examine joint dimensions and size materials to achieve required width/depth ratios.
- E. Apply primer to joint substrate where recommended by sealant manufacturer.
- F. Use joint filler to achieve required joint depths, to allow sealants to perform properly.
- G. Use bond breaker where required.

### **3.03 Sealant Installation**

- A. Perform work in accordance with ASTM C834 for latex compounds and C920 for elastomeric sealants.
- B. Install sealant in accordance with manufacturer's instructions. Apply primer where recommended by manufacturer.
- C. Apply sealant within recommended temperature ranges. Consult manufacturer when sealant cannot be applied within recommended temperature ranges.
- D. Tool joints as indicated.
- E. Joints: Free of air pockets, foreign embedded matter, ridges, and sags.

### **3.04 Sub-Slab Vapor Barrier**

- A. Install vapor barrier in accordance with ASTM E1643, unless otherwise instructed by manufacturer's written recommendations.
- B. Apply vapor barrier over entire area to receive concrete slabs.
- C. Lay membrane with seams perpendicular to, and lapped in the direction of the pour. Lap edges a minimum of 6 inches, unless otherwise instructed by manufacturer, and seal with tape. At perimeters, turn edges up to top of slab or down to bottom of footings.
- D. Tape vapor barrier tightly to pipes, conduits, and penetrations of vapor barrier. Allow no screed supports or other items to penetrate vapor barrier.

### **3.05 Form Sealer Installation**

- A. Size and install foam sealers in accordance with reference standards. Sealers shall be accurately aligned in indicated position. Install without stretching. End joints shall be scarfed.

### **3.06 Caulking**

- A. At joints or spaces deeper than ½-inch [13-mm], install joint filler to provide depth of 3/8-inch to 5/8-inch [10–16-mm].
- B. Fill space completely from back to top, without voids, flush or concave tooled as indicated, and finish uniformly smooth without laps, sags or depressions.

### 3.07 Schedule

A. This schedule reflects sealant materials specified in 2.02 of this Section. This schedule denotes sealant generic type and use or location.

<b>Specification Paragraph Number</b>	<b>Sealant</b>	<b>Use or Location</b>	<b>Joint Tooling</b>
2.02.A	2-part urethane self-leveling	Traffic areas, exterior paving, concrete and asphalt concrete, horizontal joints.	Self-leveling
2.02.B	2-part urethane non-sag	Concrete vertical joints	Concave
2.02.C	1-part urethane non-sag	Exterior cement plaster	As shown
2.02.D	1-part silicone non-sag	Glazing interior and exterior (excluding structural glazing) interior metal to metal surfaces.	As shown
2.02.E	Latex-acrylic caulk, non-sag	Interior gypsum board surfaces; interior painted wood surfaces; acoustical panels	As shown
2.02.F	Immersed service	Submerged or partially submerged conditions	As shown

**\*\*END OF SECTION\*\***

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## **SECTION 08300 ACCESS HATCHES**

### **PART 1 - GENERAL**

#### **1.01 Summary**

A. Section includes: access hatches for underground vaults using reinforced concrete.

#### **1.02 Submittals**

A. Product Data and Samples

B. Product data.

C. Shop drawings: Show the following:

1. Access door installation recommendations.
2. Locations of access doors.
3. Door size and configuration.
  - 1) Live load capacity.
4. Materials of construction and finishes provided.

#### **1.03 Delivery, Storage, and Handling**

A. Identify type and size of each floor door in a way not to damage finish prior to delivery.

B. Deliver products only after proper facilities are available.

C. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.

D. Handle carefully to prevent damage and store on clean concrete surface or raised platform in safe, dry area. Do not dump onto ground.

E. Protect floor access doors during shipment and storage to prevent warping, bending, and corrosion.

#### **1.04 Warranty**

A. Provide manufacturer's warranty against defects in material and workmanship for a period of 10 years.

### **PART 2 - PRODUCTS**

#### **2.01 Manufacturers**

A. Flygt EJCO,

B. Bilco,

C. Jenson Precast,

D. Or approved Equal.

## 2.02 Materials

### A. Aluminum Hatch with Safety Grate:

1. Style: Double leaf as indicated on the Drawings: aluminum, capable of withstanding minimum AASHTO H-20 wheel load with a maximum deflection of 1/150 of the span, live load channel frame, with drainage couplings.
2. Loading: Unit designed for heavy duty 16,000 lbs + 30% impact H-20 wheels loads over a 10'x20' contact area. Frame and Bearing plate must be cast into and supported by concrete designed for H-20 wheel loads.
3. Door Leaf: Minimum 1/4 inch, diamond pattern plate reinforced with stiffeners as required to meet specified live load.
4. Frame: Extruded aluminum with 1-1/2" anchor flange around perimeter for installation to concrete.
5. Hardware:
  - a. Hinges: Each leaf equipped with a minimum of two heavy-duty 316 Stainless Steel hinges and pins.
  - b. Lock: 316 Stainless Steel Snap/Slam lock with keyway protected by a threaded removable plug. Plug shall be installed flush with the top of the diamond plate cover. Slam lock shall be fastened with (4) 316 Stainless Steel bolts and washers.
  - c. Lift handle: Each hatch door shall be equipped with a 316 Stainless Steel lifting handle and shall recess into aluminum diamond plate cover so that the handle is set flush with top of hatch.
  - d. Each hatch shall be supplied with a grade 316 stainless steel slam lock, with key way protected by a threaded removable plug. All hardware and appurtenance shall be set flush with diamond plate covers.
  - e. Operating mechanism: Spring operators designed for ease of operation and automatic hold open arm with release handle.
  - f. Drainage assembly: Provide 1-1/2 inch drainage coupling located in front right corner of channel frame.
  - g. Safety Grate: Access Hatch shall be supplied with hinged safety grates, painted safety orange, to provide protection against fall through and control access to the confined space. (1) Safety grate shall be installed per Access Hatch door. Safety grate shall be equipped with spring operated mechanism for ease of operation and 316 stainless steel hold open arms. Safety grate shall be capable of being lifted by (1) worker.
6. All items to be included in submittals by Contractor to Construction Manager for review and approval prior to purchase by Contractor.

## 2.03 Finishes

### A. Floor access door finishes:

1. Aluminum:
  - a. 6061-T6 Aluminum for bars, angles and extrusions with manufacturer's standard mill finish.
  - b. Diamond Plate shall be 1/4" 5086 Aluminum with manufacturer's standard mill finish.
2. Aluminum In contact with dissimilar metals and concrete: Manufacturer's standard bituminous coating.

### B. Hardware finishes:

1. Provide optional Type 316 stainless steel hardware throughout, including parts of the latch and lifting mechanism assemblies, hold open arms and all brackets, hinges, pins, and fasteners.

## **PART 3 - EXECUTION**

### **3.01 Examination**

- A. Examine construction to receive floor access door and verify correctness of dimensions and other supporting or adjoining conditions.

### **3.02 Preparation**

- A. Coordinate details with other Work supporting, adjoining, or requiring access doors.
- B. Verify dimensions and profiles for each opening.
- C. Verify that location will serve portion of Work to which access is required. Where proposed functional location conflicts with other work, notify the Construction Manager before installation.
- D. Apply coating to aluminum surfaces that will be in contact with dissimilar metals or concrete when there is none.

### **3.03 Installation**

- A. Install access doors in accordance with manufacturer's instructions.
- B. Consolidate/vibrate concrete around recessed access hatch frame and embedment anchor to sufficiently remove surrounding air pockets.
- C. Support access hatch in place during concrete pour to ensure unit does not move or settle during the pour and prior to cure.
- D. Ensure correct types and adequate sizes at proper locations.
- E. Securely attach frames to supporting work and ensure doors, frames, and hardware operate smoothly and are free from warp, twist and distortion.
- F. Drain pipe installation not required.

### **3.04 Adjusting**

- A. **Adjust** doors, frames and hardware to operate smoothly, freely, and properly, without binding.

### **3.05 Cleaning**

- A. Thoroughly clean surfaces of grease, oil, or other impurities, touch up abraded prime coat where applicable as determined by the Construction Manager.

**\*\*END OF SECTION\*\***

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## SECTION 09900 PROTECTIVE COATING SYSTEMS

### PART 1 - GENERAL

#### 1.01 Summary

##### A. Scope:

1. The Contractor shall furnish all labor, materials, equipment and incidentals required to provide painting as shown and specified. The work includes the coating and finishing of all interior and exterior items and surfaces throughout the project except as otherwise shown or specified. Surface preparation, priming and coatings may be in addition to shop priming and surface treatment specified under other Sections.
2. Where items are factory-coated, repair or touch-up the factory coating and/or apply additional field coatings to achieve a complete coating system complying with the type and thickness of the coatings specified in this Section.
3. The term "coating" as used herein means all coating systems materials, which includes but is not necessarily limited to pretreatments, primers, intermediate coats, finish coats, emulsions, enamels, varnishes, stains, sealers, fillers, and other applied materials whether used as prime, intermediate or finish coats.
4. The term "exposed" as used herein means all items not covered with concrete, plaster, fireproofing or similar material.
5. Where items or surfaces are not specifically mentioned, coat these items or surfaces the same as adjacent similar materials or surfaces.
6. "Typical Examples" of items to be coated are provided on each coating system description sheet. These examples are intended to show the general scope of items to be coated are not intended to be exhaustive of all items to be coated by that particular coating.
7. Items which must be coated under this section include but are not necessarily limited to the following:
  - a. Clarifier, effluent wetwell, digesters, flow splitter box
  - b. Piping
  - c. Pipe supports
  - d. All other surfaces not otherwise excluded herein.

##### B. Coordination

1. Review installation procedures under other Sections and coordinate the installation of items that must be field coated or painted.
2. Coordinate the coating of areas to be coated that will be inaccessible once equipment has been installed.
3. Provide finish coats that are compatible with the primers used. Contractor shall be responsible for the compatibility of all shop primed and field coated items in this Contract. Barrier coats shall be provided over incompatible primers or primers shall be removed and re-primed as required.

- ##### C. Pre-Finished Items:
- Unless otherwise shown or specified, coating shall not be included when factory finishing such as baked-on enamel, porcelain, polyvinylidene fluoride, fusion bonded epoxy, or other similar finish is specified for such items.

1. Touch up factory-finished items only with coatings supplied by the item manufacturer per the requirements and instructions of the manufacturer.
2. If a factory-finished coating is applied to an item, which is not specified to receive a factory finish coat, acceptance of the factory finish coat shall be at the discretion of the Engineer. The color shall be noted with the equipment submittals.

D. Items not to be coated: The following items are excluded from coating unless otherwise specified or show:

1. Ducts, conduits and other materials with corrosion resistant surfaces that are in chases or other inaccessible areas unless specified or shown on drawings.
2. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sensing devices, motor and fan shafts unless otherwise specified.
3. Code-required labels, such as UL and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.
4. Stainless steel.
5. Copper.
6. Aluminum.
7. Fiberglass.
8. Manhole covers.
9. HVAC equipment.
10. Instrumentation and galvanized instrument supports
11. Electrical switchgear, motor control centers, panels, transformers and other similar equipment.
12. Exterior or interior concrete unless specified or shown on drawings.
13. Exterior concrete unit masonry unless specified or shown on drawings.
14. Interior concrete unit masonry unless specified or shown on drawings.

E. Related Section:

<u>Section</u>	<u>Title</u>
Section 07900	Sealants and Caulking

## 1.02 References

A. Reference Standards: Applicable provisions and recommendations of the following shall be complied with, except where otherwise shown or specified:

<u>Reference</u>	<u>Title</u>
ANSI A13.1	Scheme for the Identification of Piping Systems
Ten States Standards	Great Lakes - Upper Mississippi River Board of State Sanitary Engineers, Recommended Standards for Waste Treatment Works - Latest Edition, Recommended Color Scheme for Piping
OSHA 1910.144	Safety Color Code for Marking Physical Hazards

**Reference****Title**

SSPC Volume 2      Systems and Specification, Surface Preparation Guide and Paint Application Specifications

**1.03 Submittals**

A. Shop Drawings: The following shall be submitted for approval:

1. Manufacturer's technical information, including coating label analysis and application instructions for each material proposed for use. Each material shall be listed and cross-referenced to the specific coating system and application, and shall be identified by manufacturer's catalog number and general classification.
2. Provide itemized schedule of all the surfaces to be coated. After approval of submittals and prior to beginning work, Owner's Representative will note on the schedule the colors to be furnished.
3. Manufacturer's complete color charts for each coating system.
4. Certifications from manufacturers shall be provided, verifying that the factory applied prime coats are compatible with specified finish coatings.

**1.04 Delivery, Storage, and Handling**

A. Delivery of Materials: All materials shall be delivered to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information.

1. Name or title of material
2. Manufacturer's stock number and date of manufacture
3. Manufacturer's name
4. Contents by volume, for major pigment and vehicle constituents
5. Thinning instructions where recommended
6. Application instructions
7. Color name and number

B. Storage of Materials

1. Only acceptable project materials shall be stored on project site.
2. Store materials in compliance with manufacturer's requirements in a location approved by the Owner's Representative. Area shall be kept clean and accessible.
3. Storage shall be restricted to coating materials and related equipment only.

**PART 2 - PRODUCTS****2.01 Manufacturers:**

A. Products manufactured by one of the following shall be provided:

1. Tnemec Company, Incorporated
2. International Coatings

B. Substitutions

1. No substitutions shall be considered that decrease the film thickness, the number of coats, the surface preparation or the generic type of coating specified. Approved manufacturers must furnish the same color selection as the manufacturers specified, including accent color in all coating systems.

## **2.02 Materials**

- A. Only the best grade of the various types of coating suitable for use in water and wastewater treatment plants, as regularly manufactured by acceptable coating material manufacturers, shall be provided. Material not displaying the manufacturer's identification as a best-grade product will not be acceptable.
- B. Primers shall be produced by the same manufacturer as the intermediate and finish coats. Use only thinners recommended by the manufacturer, and use only to recommended limits.
- C. Coatings and pipe markers of durable and washable quality shall be provided. Materials that will withstand normal washing as required to remove grease, oil, chemicals, etc., without showing discoloration, loss of gloss, staining, or other damage shall be used.

## **2.03 Colors and Finishes**

- A. Surface treatments, and finishes, are shown under Coating Systems below. All substrates indicated shall be coated whether or not shown on the Drawings, or in Schedules, unless an item is specifically scheduled as not requiring coating.
- B. Color Selection
  1. The Owner reserves the right to select non-standard colors for all coating systems specified within the ability of the manufacturer to produce such non-standard colors. Selection of non-standard colors shall not be cause for the Contractor rejecting Owner's color selections and the Contractor shall supply such colors at no additional expense to the Owner.
- C. Piping Color Code:
  1. To be selected by the Owner.
- D. Color Pigments: Pure, non-fading, applicable types to suit the substrates and service indicated.

## **2.04 Coating Systems**

- A. Refer to the following Coating System Sheets.
- B. The Contractor shall coat all items, which fall into the categories described. The examples given on the coating system sheets are presented for the Contractor's convenience, and may not include all items which require coating. In general all exposed ferrous materials shall be coated. This includes galvanized materials and shop primed material unless specifically excluded elsewhere.

## Coating System 1

### A. Service:

1. Structural steel, miscellaneous metals, and steel, ductile iron, or cast iron piping
2. Interior exposure
3. Non-submerged applications (greater than 3' above highest possible water level).

### B. Typical Examples:

1. All exposed structural steel including but not limited to columns, beams, roof joists, purlins and other supporting members.
2. Equipment including but not limited to pumps, blowers, air compressors, valves, and other process equipment, motors, gear reducers, and equipment guards.
3. Steel, ductile, or cast iron piping not otherwise coated as specified in piping sections.

### C. Surface Preparation:

1. Shop: SSPC-SP 10/NACE No.2 Near-White Blast Clean, as specified in herein.
2. Field: Sandblasting of field welds and other imperfections. Owner's Representative may require all areas to be blasted at his discretion, SSPC-SP 10/NACE No.2 Near-White Blast Clean, commercial blast as specified in herein.

### D. Product and Manufacturer: One of the following shall be provided:

1. Tnemec
  - a. Primer: Series V69 Hi-Build Epoxoline II - one coat, 3.0 - 5.0 total dry mils thickness
  - b. Finish: Series G435 Perma Glaze - one or two coats, 15.0 - 20.0 total dry mils thickness
2. Or equal

## Coating System 2

### A. Service:

1. Structural steel, miscellaneous metals, and steel, ductile iron, or cast iron piping
2. Exterior exposure
3. Non-submerged applications (greater than 3' above highest possible water level)

### B. Typical Examples:

1. All exposed structural steel including but not limited to columns, beams, roof joists, purlins and other supporting members.
2. Equipment including but not limited to pumps, blowers, air compressors, valves, other process equipment, motors, gear reducers, and equipment guards.
3. Overhead coiling and man doors if not specified door elsewhere.
4. Steel, ductile, or cast iron piping not otherwise coated as specified in piping sections.

### C. Shop Surface Preparation:

1. Shop: SSPC-SP 6/NACE No.3 - Commercial Blast Clean as specified in herein
2. Field: Sandblasting of field welds and other imperfections. Owner's Representative may require all areas to be blasted at his discretion, SSPC-SP 6/NACE no. 3, Commercial Blast Clean as specified in herein.

### D. Products and Manufacturer: One of the following shall be provided:

1. Tnemec
  - a. Primer: Series V69 Hi-Build Epoxoline II - one coat, 3.0 - 5.0 total dry mil thickness
  - b. Intermediate: Series V69 Hi-Build Epoxoline II - one coat, 3.0 - 5.0 total dry mil thickness
  - c. Finish: Series 1075 Endura-Shield - one or more coats, 3.0 - 5.0 total dry mil thickness
2. Or equal

### Coating System 3

A. Service:

1. Galvanized structural steel, galvanized miscellaneous metals, and galvanized steel pipe.
2. Interior exposure
3. Non-submerged applications (greater than 3' above highest possible water level)

B. Typical Examples:

1. All exposed galvanized structural steel including but not limited to columns, beams, roof joists, purlins and other supporting members.
2. Flashing.
3. Galvanized rigid conduit.

C. Surface Preparation:

1. Solvent Cleaning, SSPC-SP 1 as specified in herein, followed by brush off blast cleaning per SSPC-SP16 to provide an anchor profile of 1.5 to 2.0 mils minimum

D. Product and Manufacturer: One of the following shall be provided:

1. Tnemec
  - a. Primer: Series V69 Hi-Build Epoxoline II - one coat, 2.0 - 3.0 total dry mil thickness
  - b. Finish: Series V69 Hi-Build Epoxoline II - one coat, 2.0 – 3.0 dry total dry mil thickness
  - c. Total DFT not to exceed 7.0 mils DFT.
2. Or equal

## Coating System 4

### A. Service:

1. Galvanized structural steel, galvanized miscellaneous metals, and galvanized steel pipe.
2. Aluminum tube
3. Exterior exposure
4. Non-submerged applications (greater than 3' above highest possible water level)

### B. Typical Examples:

1. All exposed galvanized structural steel including but not limited to columns, beams, roof joists, purlins and other supporting members.
2. Flashing
3. Galvanized rigid conduit
4. Bollards
5. All buried and exposed aluminum tubing in contact with dissimilar materials including but not limited to other metals, concrete, wastewater, and soil.

### C. Surface Preparation:

1. Solvent Cleaning, SSPC-SP 1 as specified in herein, followed by brush off blast per SSPC-SP16 to provide an anchor profile of 1.5 to 2.0 mils minimum

### D. Product and Manufacturer: One of the following shall be provided:

1. Themec
  - a. Primer: Series V69 Hi-Build Epoxoline II – one coat, 2.0 - 3.0 total dry mil thickness
  - b. Finish: Series 1075 Endura-Shield -- one coat, 2.0 - 3.0 total dry mil thickness
  - c. total DFT not to exceed 7.0 mils.
2. Or equal

## Coating System 5

### A. Service:

1. Structural steel, miscellaneous metals and steel, ductile iron, or cast iron piping
2. Submerged, intermittently submerged, or splash zone applications (within 3' of highest possible water level).

### B. Typical Examples:

1. Structural steel
2. Steel, ductile, or cast iron piping not otherwise coated as specified in piping sections.
3. Pump base elbows, pumps, mixers and other process equipment
4. Pipe supports

### C. Surface Preparation:

1. Shop: SSPC-SP 10/NACE No. 2 Near-White Blast Cleaning
2. Field: Sandblasting of field welds and other imperfections. Owner's Representative may require all areas to be blasted at his discretion, SSPC-SP10/NACE No.2 Near-White Blast Cleaning as specified in herein.

### D. Product and Manufacturer: One of the following shall be provided:

1. All systems described in Paragraph B except pumps
  - a. Tnemec
    - 1) Primer: Series V69 Hi-Build Epoxoline II - one or more coats, 3.0 - 5.0 total dry mil thickness
    - 2) Intermediate: Series V69 Hi-Build Epoxoline II - one or more coats, 3.0 - 5.0 total dry mil thickness
    - 3) Finish: Series V69 Hi-Build Epoxoline II - one or more coats, 3.0 - 5.0 total dry mil thickness
  - b. Or equal
2. Pumps
  - a. Tnemec
    - 1) Primer: Series V69 Hi-Build Epoxoline II - one or more coats, 3.0 - 5.0 total dry mil thickness
    - 2) Finish: Series V69 Hi-Build Epoxoline II - one or more coats, 3.0 - 5.0 total dry mil thickness
  - b. Or equal

## Coating System 6

### A. Service:

1. Galvanized structural steel, galvanized miscellaneous metals, and galvanized steel pipe.
2. Submerged, intermittently submerged, or splash zone applications (within 3' of highest possible water level).

### B. Typical Examples:

1. Structural steel
2. Steel piping not otherwise coated as specified in piping sections.
3. Pump base elbows, pumps, mixers and other process equipment
4. Pipe supports

### C. Surface Preparation:

1. Solvent Cleaning, SSPC-SP 1 as specified in herein, followed by brush off blast to provide an anchor profile of 1.5 to 2.0 mils minimum

### D. Product and Manufacturer: One of the following shall be provided:

1. All systems described in Paragraph B
  - a. Tnemec
    - 1) Primer: Series V69 Hi-Build Epoxoline II -- one or more coats, 3.0 - 5.0 total dry mil thickness
    - 2) Intermediate: Series V69 Hi-Build Epoxoline II -- one or more coats, 3.0 - 5.0 total dry mil thickness
    - 3) Finish: Series V69 Hi-Build Epoxoline II -- one or more coats, 3.0 - 5.0 total dry mil thickness
  - b. Or equal

## Coating System 7

### A. Service:

1. Plastics including PVC and CPVC Piping
2. Interior or exterior exposure
3. Non-submerged applications

### B. Typical Example:

1. Exposed PVC and CPVC piping.
2. Notable Exceptions:
  - a. Do not coat submerged or partially submerged plastic piping.
  - b. Do not coat plastic valves, unions, valve handles or other similar plastic items.
  - c. Do not coat exposed PVC conduit or exposed rigid steel with PVC coating conduit.

### C. Surface Preparation:

1. Plastic shall be prepared in accordance with SSPC SP-1 (Solvent Cleaning) followed by SSPC-SP 2 (Hand Tool cleaning). Contractor shall use a solvent compatible with the specified coating and roughen surfaces by sanding.

### D. Product and Manufacturer: One of the following shall be provided:

1. Carboline
  - a. Finish: Carbothane 134VOC – two coats, 5.0 total dry mil thickness
2. Tnemec
  - a. Finish: Tnemec Series 1075 – two coats, 2.0 to 3.0 mils DFT per coat for a minimum 5.0 total dry mil thickness
3. International
  - a. Finish: ICI Devoe Devthane 378H - two coats, 5.0 total dry mil thickness
4. Or equal

## Coating System 8

### A. Service:

1. Clarifier: Internal structural concrete walls from top of wall to 1' below elevation 3675.93' (minimum water level).
2. Clarifier's launders: internal structural concrete weir, floor and walls of launders.
3. Effluent Pump Station: Full height of internal structural concrete walls.
4. Digesters: Internal structural concrete walls from top of wall to 1' below minimum elevation setting for telescoping valve.
5. Flow Splitter Box: Full height of internal structural concrete walls, including weirs.

### B. Surface Preparation:

1. Prepare all surfaces to receive coating per manufacturer's recommendations.

### C. Product and Manufacturer

1. Tnemec Epoxytec CPP Sprayline or Epoxytec CPP Trowel Liner – one coat, 125 mils DFT minimum. Apply per manufacturer's recommendations.
2. Sauereisen 210S -- one coat, 60 mils total dry mil thickness. Apply per manufacturer's recommendations.
3. SewperCoat – one coat, Apply per manufacturer's recommendations.
4. Endura-Flex 1988 – 120 mils, Apply per manufacturer's recommendations
5. Sherwin-Williams – Dura-Plate 6100 epoxy, 1 coat, 80 – 100 dry mil thickness. Apply per manufacturer's recommendations.
6. Madewell
  - a. Basecoat: Mainstay ML-72 microsilica cement, 1-inch minimum.
  - b. Topcoat: Mainstay DS-5 Epoxy, 100 mils.
  - c. Applied by manufacturer's certified applicator.
  - d. Apply per manufacturer's recommendations.
7. Quadex, GeoKrete Polymer Concrete, 1-inch minimum.
  - a. Applied by manufacturer's certified applicator.
  - b. Apply per manufacturer's recommendations.

## **PART 3 - EXECUTION**

### **3.01 Examination**

- A. The Contractor and his applicator shall examine the areas and conditions under which painting work is to be performed and notify the Owner's Representative in writing of conditions detrimental to the proper and timely completion of the Work. The Contractor shall not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Owner's Representative.
- B. The Contractor shall not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

### **3.02 Preparation**

#### **A. Coordination:**

- 1. The Contractor shall review installation procedures under other Sections and coordinate the installation of items that must be field painted in this Section.
- 2. The Contractor shall coordinate the painting of areas to be painted that will be inaccessible once equipment has been installed.
- 3. The Contractor shall provide finish coats that are compatible with the prime paints used.
- 4. The Contractor shall review other Sections of these Specifications in which prime paints are to be provided to ensure compatibility of the total coatings system for the various substrates.
- 5. The Contractor shall be responsible for the compatibility of all shop primed and field painted items in this Contract.
- 6. The Contractor shall furnish information on the characteristics of the finish materials proposed to use, to ensure that compatible prime coats are used. Barrier coats shall be provided over incompatible primers or primers shall be removed and re-primed as required.

#### **B. Protection:**

- 1. Finished Work of other trades and surfaces not being painted concurrently or not to be painted shall be covered or otherwise protected.
- 2. Work of other trades shall be protected, whether to be painted or not, against damage by the painting and finishing work. All such work shall be left undamaged. All damage shall be corrected by cleaning, repairing or replacing, and repainting, as acceptable to the Owner's Representative.
- 3. Wet Paint signs shall be provided as required to protect newly painted finishes. All temporary protective wrapping provided for protection of this Contract shall be removed after completion of painting operations.

#### **C. Surface Preparation**

##### **1. General:**

- a. All preparation and cleaning procedures shall be performed as specified herein and in strict accordance with the paint manufacturer's instructions for each particular substrate and atmospheric condition.
- b. All hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish painted shall be removed or provided surface applied protection prior to surface preparation and painting operations. The Contractor

shall remove, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, the removed items shall be reinstalled by workmen skilled in the trades involved.

- c. Surfaces to be painted shall be cleaned before applying paint or surface treatments. Oil and grease shall be removed with clean cloths and cleaning solvents prior to mechanical cleaning. The cleaning and painting shall be programmed so that dust and other contaminants from the cleaning process will not fall in wet, newly painted surfaces.
- d. All surfaces that were not shop painted or that were improperly shop painted, and all abraded or rusted shop painted surfaces, which are to be painted, as determined by the Owner's Representative, shall be prepared as specified below.

## 2. Concrete and Masonry Surfaces:

- a. Surfaces of concrete, precast concrete, and concrete block to be painted and sealed with clear finish shall be prepared by removing all efflorescence, chalk, dust, dirt, grease and oils with soap and water.
- b. The alkalinity and moisture content of the surfaces to be painted shall be determined by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, this condition shall be corrected before application of paint. The Owner's Representative shall be provided with suitable testing materials to carry out alkalinity and moisture tests.
- c. The Contractor shall not paint over surfaces where the moisture content exceeds 8 percent, unless otherwise permitted in the manufacturer's printed directions.
- d. Concrete and concrete block surfaces that cannot be adequately cleaned by soap and water shall be acid etched. Exceedingly dense concrete may require a second etching.
- e. Brush blast clean shall be equivalent to SSPC-SP 7, to open bug holes and remove all non-adhering concrete. All areas so prepared shall be thoroughly cleaned before beginning coating work.

## 3. Ferrous Metals:

- a. Non-submerged ferrous surfaces, including structural steel and miscellaneous metal to be shop primed, shall be cleaned of all oil, grease, dirt, mill scale and other foreign matter by commercial blast cleaning complying with SSPC-SP 6.
- b. Submerged ferrous surfaces, including structural steel and miscellaneous metal to be shop primed, shall be cleaned of all oil, grease, dirt, mill scale and other foreign matter by near-white blasting complying with SSPC-SP 10.
- c. Non-submerged, ferrous surfaces that have not been shop-coated shall be cleaned of all oil, grease, dirt, loose mill scale and other foreign substances by commercial blasting, complying with SSPC-SP 6.
- d. Submerged ferrous surfaces that have not been shop-coated or that, in the opinion of the Owner's Representative, have been improperly shop-coated, shall be cleaned of all oil, grease, dirt, mill scale and other foreign matter by near-white blasting complying with SSPC-SP 10.
- e. Bare and blasted or pickled clean metal shall be treated with metal treatment wash coat, prior to priming only if recommended by the paint manufacturer.
- f. Shop applied prime coats that have damaged or bare areas shall be touched-up with primer recommended by the coating manufacturer after commercial blasting complying with SSPC-SP 6.

- g. Weld Preparation: Remove weld spatter and slag by chipping or grinding. Grind all sharp edges and corners to a smooth contour. Welds to be ground free from undercuts, recesses and pinholes.

4. Non-Ferrous Metal Surfaces:

- a. Non-ferrous metal surfaces shall be cleaned in accordance with the coating system manufacturers instructions for the type of service, metal substrate, and application required.

5. Galvanized Surfaces:

- a. The Contractor shall clean free of oil and surface contaminants with solvent or other methods recommended by the coating manufacturer, complying with SSPC-SP 1.
- b. All coated galvanized ferrous metal, interior and exterior, shall be cleaned of all oil, grease, dirt, mill scale and other foreign matter by a brush-off blast cleaning complying with SSPC-SP 7 with 1.5 to 2.0 mils profile.

D. Materials Preparation

1. General:

- a. Painting materials shall be mixed and prepared in strict accordance with the manufacturer's directions.
- b. Coating materials produced by different manufacturers shall not be mixed, unless otherwise permitted by the manufacturer's instructions.
- c. Materials not in actual use shall be stored in tightly covered containers. Containers used in storage, mixing, and application of paint shall be maintained in a clean condition, free of foreign materials and residue.
- d. All materials shall be stirred before application to produce a mixture of uniform density, and as required during the application of the materials. Any film that may form on the surface shall not be stirred into the material. The film shall be removed and, if necessary, the material shall be strained before using.
- e. Brush stripe edges and corners to achieve specified coating thickness and coverage.

2. Tinting:

- a. Each undercoat shall be tinted a lighter shade to facilitate identification of each coat where multiple coats of the same material are to be applied. Undercoats shall be tinted to match the color of the finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat. A code number shall be provided to identify material tinted by the manufacturer.

3. Mixing:

- a. The Contractor shall mix only in mixing pails placed in a suitably sized non-ferrous or oxide resistant metal pans to protect concrete floor from splashes or spills which could stain exposed concrete or react with subsequent finish floor material.
- b. Paint shall be mixed and applied only in containers bearing accurate product name of material being mixed or applied.

**3.03 Application**

A. General:

- 1. Paint shall be applied by mechanical application techniques such as roller, brush, trowel, air spray, or airless spray in accordance with the manufacturer's directions and recommendations

of Paint Application Specifications No. 1 in SSPC Vol. 2, where applicable, or as required in these Specifications. Brushes best suited for the type of material being applied shall be used. Where approved by the Owner's Representative, rollers of carpet, velvet back, or high pile sheep's wool shall be used, as recommended by the paint manufacturer for material and texture required.

2. The number of coats and paint film thickness required is the same regardless of the application method. Succeeding coats shall not be applied until the previous coat has completely dried.
3. Where multiple coats of the same material is used, tint prime and intermediate coats in order to distinguish each coat.
4. Additional coats shall be applied when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. This is of particular importance regarding intense primary accent colors. The Contractor shall insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a film thickness equivalent to that of flat surfaces.
5. Surfaces not exposed to view do not require color coding but require the same coating systems specified for exposed surfaces. Exposed to view surfaces are defined as those areas visible when permanent or built-in fixture, convector covers, covers for finned tube radiation, grilles, etc., are in place in areas scheduled to be painted.
6. The backs of access panels and removable or hinged covers shall be painted to match the exposed surfaces.
7. Aluminum parts in contact with dissimilar materials shall be painted as specified with appropriate finish.
8. Brush stripe welds; bolts; nuts; edges and corners to achieve proper coating thicknesses.

B. Electrical Work:

1. Electrical items to be painted include, but are not limited to, the following:
  - a. Conduit and fittings.
  - b. Miscellaneous panels, junction boxes, motors and accessories.

C. Minimum / Maximum Coating Thickness:

1. The Contractor shall apply each material at not less than the manufacturer's recommended spreading rate, and provide total dry film thickness as specified. Extra coat shall be applied if required to obtain specified total dry film thickness or uniform opacity. If the recommended maximum coating thickness is exceeded, the excess amount will be removed and repaired as specified.

D. System Coating Thickness:

1. The system total dry mil thickness shall be the sum of the Primer, Intermediate and Finish Coats specified.

E. Scheduling Painting:

1. The first-coat material shall be applied to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration. Abrasive blasted ferrous metal surfaces shall be coated within eight (8) hours on the same day of abrasive blasting.
2. Subsequent coats shall be applied as per manufacturer's written recoat parameters as detailed on their product data sheet. Sufficient time between successive coatings shall be

allowed to permit proper drying. The Contractor shall not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

F. Prime Coats:

1. Primed and sealed walls and ceilings shall be recoated where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects caused by insufficient sealing.

G. Pigmented (Opaque) Finish:

1. The Contractor shall completely cover to provide an opaque, smooth surface of uniform finish, color, appearance, and coverage.

H. Brush Application:

1. All brush coats shall be brushed-out and worked onto the surfaces in an even film. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable. All glass and color break lines shall be neatly drawn.

I. Mechanical Applicators:

1. Mechanical methods shall be used for paint application as suggested by the paint manufacturer. Conduct spray coating under controlled conditions. Protect adjacent structure for overspray.
2. For spray application, apply coating to thickness not greater than suggested in paint manufacturer's instruction.
3. Wherever spray application is used, each coat shall be applied to provide the equivalent hiding of brush-applied coats. Do not double back with spray equipment for the purpose of building up film thickness of 2 coats in one pass.

### 3.04 Field Quality Control

A. The right is reserved by the Owner's Representative to invoke the following material testing procedure at any time, and any number of times during the period of field painting:

1. Engage the service of an independent testing laboratory to sample any of the paint being used. Samples of materials delivered to the project site will be taken, identified and sealed, and certified in the presence of the Contractor.
2. The testing laboratory will perform appropriate tests for any or all of the following characteristics: Abrasion resistance, apparent reflectivity, flexibility, washability, absorption, accelerated weathering, dry opacity, accelerated yellowness, recoating, skinning, color retention, alkali resistance and quantitative material analysis.
3. If the test results show that the material being used does not comply with the specified requirements, the Contractor may be directed to stop the painting Work, and remove the non-complying paint; pay for testing; repaint surfaces coated with the rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with the specified paint, the two coatings are non-compatible.

B. Prior to initial coat and after completion of each successive coat of paint, the Contractor shall notify the Owner's Representative. After inspection, checking of film thickness and approval by the Owner's Representative, proceed with the succeeding coat. Contractor shall supply the Owner's Representative for his use a Gardner dry-film thickness gage.

### **3.05 Cleaning**

- A. During the progress of the Work, all discarded paint materials, rubbish, cans and rags shall be removed from the site at the end of each work day.
- B. Upon completion of painting work, all paint-spattered surfaces shall be cleaned. Spattered paint shall be removed by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
- C. At the completion of work of other trades, all damaged or defaced painted surfaces shall be touched-up and restored, as determined by the Owner's Representative.

### **3.06 Demonstration**

- A. Completed Work:
  - 1. The Contractor shall match approved samples for color, texture and coverage.
  - 2. Work not in compliance with specified requirements shall be removed, refinished or repainted, as required by the Owner's Representative.

**\*\* END OF SECTION \*\***

## SECTION 11010 GENERAL REQUIREMENTS FOR EQUIPMENT

### PART 1 - GENERAL

#### 1.01 Summary

- A. Scope: This section provides the general requirements that must be met by all equipment supplied under this Contract.
- B. Equipment Lists: Equipment lists, if any, presented in these specifications and shown on the drawings are included for the convenience of the Engineer and Contractor and are not intended to represent a rigorous and precise listing of all equipment, devices and material to be provided under this Contract.

#### 1.02 Submittals

- A. General: The submittal for each piece of equipment or groups of related equipment shall be in accordance with Section 01300 – Submittals.
- B. Required Submittal Data: In addition to the data required elsewhere, the following information shall be submitted for each piece of equipment. Additional submittal requirements, specific to individual equipment items, are listed in the individual equipment specifications.
  - 1. The proposed equipment shall be identified by the equipment numbers listed in the specifications and on the drawings.
  - 2. Manufacturer and manufacturer's type designation.
  - 3. A photocopy of the equipment specifications shall be included. All paragraphs shall be initialed to show compliance. Any exceptions to the specifications along with justification for each exception shall be clearly presented.
  - 4. Manufacturer's catalog data confirming rated capacity, horsepower, efficiency and electrical requirements.
  - 5. Shop drawings.
  - 6. Predicted performance curves developed for the specific application. In the case of rotating equipment, performance curves shall show speed, capacity, pressure, efficiency and power for all specified conditions.
  - 7. Motor submittal data as required under Section 11060 – Electric Motors.
  - 8. Cross-sectional views of machines showing details of construction.
  - 9. Data and calculations required to justify selection of size of components such as shafts, bearings, and peripheral equipment necessary to conform to these specifications.
  - 10. Parts lists, with materials of construction.
  - 11. Installation, startup, and shakedown requirements noting all items to be inspected and confirmed at each stage of installation, startup, and shakedown.
  - 12. An electronic copy of the main equipment Operation and Maintenance manual(s) for general information as part of initial equipment submittal.
  - 13. Contractor shall certify that all shop applied coatings are compatible with the approved field coating system specified in Section 09900 – Protective Coating Systems. If a barrier coating is required, the Contractor shall so state.

### 1.03 Quality Assurance

- A. Arrangement: The arrangement of equipment shown on the drawings is based upon information available at the time of design and is not intended to show exact dimensions peculiar to a specific manufacturer unless otherwise indicated. The drawings are, in part, diagrammatic and some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements. Structural supports, foundations, connected piping and valves shown may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations.
- B. Control Devices: Control devices, wiring, starters, panels, light, and other electrical items provided with mechanical equipment shall, in general, conform to the requirements of Division 16 as well as any requirements of the particular equipment specification.
- C. Equipment Structural Integrity:
1. Equipment shall be designed with internal structural integrity and ruggedness to withstand loads associated with:
    - 1) Incidental impact
    - 2) Transportation
    - 3) Rigging and handling
    - 4) Vibrations from internal moving parts and nearby equipment
  2. Seismic Certification
    - 1) All equipment that has parts that rotate, move mechanically, or are energized (with AC or DC power) during operation must be certified to remain operational during and after design earthquake ground motion (2/3 of Maximum Considered Earthquake "MCER" ground motion). In no case shall the design earthquake ground motion be associated with spectral acceleration response "SDS" less than 1.0g.
    - 2) Seismic certification shall be on the basis of approved shake table testing per ICC-ER AC156 or equal. Analysis alone is not an acceptable method of certification, except for:
      - a) Units with weights less than 400 lbs
      - b) Motors less than 10 hp
      - c) Transformers
      - d) Equipment where all components are inherently rugged as deemed by a State of California registered Civil, Structural, or Mechanical Engineer.
    - 3) Alternative Certification: Experience data from post-earthquake evaluations based on nationally-recognized procedures, combined with detailed analysis by a State of California registered Structural Engineer, constitutes seismic certification.
  3. Structural anchorage: per Specification Section 11050 – Equipment Mounting.

## PART 2 - PRODUCTS

### 2.01 Flanges and Pipe Threads

- A. Flanges on equipment and appurtenances provided under this section shall conform in dimensions and drilling to ANSI B16.1 (unless otherwise specified metric dimensioned flanges not allowed). Unless otherwise specified, flanges shall be flat faced.

- B. Flange assembly bolts shall be heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2. Threads shall be Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.
- C. Unless otherwise specified, pipe threads shall conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit. Threaded flanges shall have a standard taper pipe thread conforming to ANSI B2.1.

**2.02 Bearings**

- A. Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified. Each bearing shall be rated in accordance with the latest revisions of AFMBA Methods of Evaluating Load Ratings of Ball and Roller Bearings for one of the following classes of B-10 rating life:

<u>Class</u>	<u>Hours of Operation</u>
M1	8,000
M2	20,000
M3	50,000
M4	100,000
M5	200,000

- B. Unless otherwise specified, equipment shall have bearings rated for Class M4 life or greater.
- C. Grease lubricated bearings, except those specified to be factory sealed and lubricated, shall be fitted with easily accessible grease supply, flush, drain and relief fittings. Extension tubes shall be used when necessary. Grease supply fittings shall be standard hydraulic Alemite type.
- D. Oil lubricated bearings shall be equipped with either a pressure lubricating system or a separate oil reservoir type system. Each oil lubrication system shall be of sufficient size to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60 degrees C and shall be equipped with a filler pipe and an external level indicator gauge.

**2.03 V-Belt Assemblies**

- A. Unless otherwise specified, V-belt assemblies shall be Dodge Dyna-V belts with matching Dyna-V sheaves and Dodge Taper-lock bushings, Wood’s Super V-Belts with matching Sure-Grip sheaves and Wood’s Sure-Grip bushings, or equal.
- B. Sheaves and bushings shall be statically balanced. Additionally, sheaves and bushing which operate at a peripheral speed of more than 550 feet per minute shall be dynamically balanced. Sheaves shall be separately mounted on their bushings by means of three pull-up or cap tightening screws. Bushings shall be key seated to the drive shaft.
- C. Belts shall be selected for not less than 150 percent of rated driver horsepower and, where two sheaves sizes are specified, shall be capable of operating with either set of sheaves. Belts shall be of the antistatic type where explosion-proof equipment is specified.

**2.04 Seals**

- A. Mechanical Seals
  - 1. Unless otherwise specified, mechanical seals may be internal or external type, balanced or unbalanced type, and single or double seals except as herein specified. An internal type seal may be used where clean sealing liquid is provided, either from the pumped liquid or an

external source. When the pumped liquid is corrosive, abrasive, toxic or flammable, an internal double seal shall be provided with adequate sealing liquid pressure to prevent entry of pumped liquid into the seal chamber, or an external seal may be provided. The sealing liquid shall be within the temperature limits and at the flushing rate recommended by the equipment manufacturer.

2. The seal may be balanced or unbalanced, as recommended by the equipment manufacturer. To maintain the necessary minimum or maximum pressure across the seal faces, spring pressure shall be uniformly distributed to the sealing faces by a coil spring or multiple springs. The rotating seal element shall be clamped to the shaft and provided with O-ring seal. The stationary seal element shall be sealed with O-ring or gasket material.
  3. Seal faces shall be tungsten carbide to tungsten carbide except on the double seal where the seal in contact with pump liquid shall be carbon. The O-ring gasket material shall be as recommended by the manufacturer for the liquid being pumped. Other parts shall be 316 stainless steel.
- B. **Stuffing Box:** Unless otherwise indicated, each stuffing box shall be cast separately, bolted to the bearing frame, tapped to permit installation of a clean liquid seal, and shall be large and sufficiently deep to hold a minimum of five rows of packing and a bronze lantern water seal ring. Packing shall be die-molded packing rings of material suitable for the intended service and as recommended by the manufacturer. Sealing liquid shall be the pumped liquid unless otherwise specified. Taps for external sealing and a lantern ring shall be provided. When used, lantern rings shall be of two-piece construction and shall be provided with tapped holes to facilitate removal. Packing gland halves and studs shall be 316 stainless steel.

## **2.05 Couplings**

- A. Unless otherwise specified in the particular Equipment Sections, equipment with a driver greater than 2 HP, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations. The flexible member shall consist of a tire with synthetic tension members bonded together in rubber. The flexible member shall be attached to flanges by means of clamping rings and cap screws, and the flanges shall be attached to the stub shaft by means of taperlock bushings which shall give the equivalent of a shrunk-on-fit. There shall be no metal-to-metal contact between the driver and the driven unit. Each coupling shall be sized and provided as recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.
- B. Where torque or horsepower capacities of couplings of the foregoing type is exceeded, Thomas-Rex, Falk Steel Flex, or equal, couplings will be acceptable provided they are sized in accordance with the equipment manufacturer's recommendations and sizing data are submitted. They shall be installed in conformance to the coupling manufacturer's instructions.

## **2.06 Guards**

- A. Exposed moving parts shall be provided with guards which meet the requirements of CAL/OSHA. Unless otherwise indicated, guards shall be fabricated of solid 14-gauge steel. Guards shall be galvanized after fabrication and shall be designed to be readily removable to facilitate maintenance of moving parts. Reinforced holes shall be provided.

## **2.07 Caution Signs**

- A. Equipment with guarded moving parts which operates automatically or by remote control shall be identified by signs reading "CAUTION – AUTOMATIC EQUIPMENT MAY START AT ANY TIME."

Signs shall be in accordance with Section 10405. Signs shall be installed near guarded moving parts.

## **2.08 Pressure Taps, Test Plugs, and Gauges**

- A. Weather shown or not shown on the drawings, 1/2" pressure taps w/plugs shall be provided on the suction and discharge sides of all pumps, blowers and compressors. Pressure and vacuum test gauges shall be provided where shown or specified.

## **2.09 Nameplates**

- A. Nameplates shall be provided on each item of equipment and shall contain the specified equipment name or abbreviation. Equipment nameplates shall be engraved or stamped on corrosion resistant material and fastened to the equipment in an accessible location with a No. 4 or larger oval head stainless steel screws or drive pins.

## **2.10 Lubricants**

- A. The Contractor shall provide for each item of mechanical equipment a supply of the lubricant required for the initial filling and for the commissioning period.
- B. Lubricants shall be of the type recommended by the equipment manufacturer and shall be products of the Owner's current lubricant supplier.
- C. The Contractor shall limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types. Not less than 90 days before the date shown in his construction schedule for starting, testing, and adjusting equipment, the Contractor shall provide the Owner with three copies of a list showing the required lubricants, after consolidation, for each item of mechanical equipment. The list shall show estimated quantity of lubricant needed for a full year's operation, assuming the equipment will be operating continuously.

## **2.11 Spare Parts**

- A. Parts and materials shall be furnished in manufacturer's unopened cartons, boxes, crates or other protective covering suitable for preventing corrosion or deterioration for the maximum length of storage that may be normally anticipated. They shall be clearly marked and identified.
- B. During construction, parts shall be stored in buildings or trailers with floor, roof and closed sides and in accordance with manufacturer's recommendations. They shall be protected from weather, condensation and humidity, and corrosive gasses.
- C. Spare parts and materials shall be delivered to the Owner upon completion of the Work or when the Owner assumes beneficial occupancy. Contractor shall then place them in permanent storage rooms or areas approved by the Owner's Representative.
- D. A letter of transmittal shall accompany the spare parts and shall include the following:
  - 1. Date of letter and transfer of parts and material
  - 2. Contract title and number
  - 3. Contractor's name and address
  - 4. A complete inventory of the parts and material, listing the applicable Specification Section for each
  - 5. A place for the Owner to sign and signify receipt of the parts and materials
- E. Contractor shall be fully responsible for loss or damage to parts and material until they are transmitted to the Owner.

## **PART 3 - EXECUTION**

### **3.01 Installation, Testing, and Commissioning**

- A. Unless otherwise specified each item of equipment shall be installed, tested, and commissioned within the tolerances recommended by the equipment manufacturer and the requirements of Sections 01660 and 11070.

**\*\*END OF SECTION\*\***

## **SECTION 11050 EQUIPMENT MOUNTING**

### **PART 1 - GENERAL**

#### **1.01 Summary**

- A. This section includes the requirements for supply and installation of mounts, supports, and anchorage hardware for all equipment and accessories including but not limited to pipes, fans, ducts, etc. required to make a complete system.

#### **1.02 Design Requirements**

- A. Requirements of Regulatory Agencies: All tanks, and related piping, equipment and related supports and equipment anchorages shall be designed and supplied by the Contractor in accordance with National and State requirements including but not limited to CBC, AWWA & ANSI Standards.
- B. Project Specific Requirements: See the structural drawings for project specific seismic and wind load parameters.
- C. Additional Design Requirements:
1. In addition to code requirements, anchors and supports shall be designed to allow for expansion and contraction throughout the full potential temperature differential (both operational and off-line conditions).
  2. Anchors shall be capable of supporting equipment and accessories in all service and testing conditions.
  3. Anchorage shall allow for proper leveling.
  4. Allowances shall be provided for horizontal and vertical adjustment after installation and operation.
  5. Supports shall not block routine servicing of equipment.
  6. Supports shall be compatible with the removal of equipment for replacement.
  7. Existing reinforcing bars shall not be damaged during drilling or installation of anchorage.

#### **1.03 Submittals**

- A. The following items shall be submitted in accordance with the requirements of Sections 01300 and 11010:
1. Calculations for all of the work required above. All calculations must be made and signed by a Civil or Structural Engineer currently registered in the State of California including seismic design per Section 01610.
  2. Design codes and criteria used
  3. Equipment weight, support points, and center of gravity
  4. Anchor and hardware details,
  5. Concrete embeds (if any)
  6. Isolation mounts (vibratory and reciprocating equipment)

#### **1.04 Quality Assurance**

- A. Allow for special inspection for the installation of chemical anchors in accordance with CBC requirements.
- B. Expansion type anchors or adhesive type anchors shall not be allowed as a substitute for cast-in-place anchors.

## **PART 2 - PRODUCTS**

### **2.01 General**

- A. All equipment located on floor slabs shall be mounted on concrete pads. Where a steel or cast base is shown or specified between the equipment and the concrete pedestal, it shall be hot-dip galvanized after fabrication.

### **2.02 Materials**

- A. Unless otherwise specified on the drawings, materials of construction for anchoring devices shall conform to the following:
  - 1. Anchor bolts and other anchoring devices, nuts, and washers shall be type 304 stainless steel.
  - 2. Anchor bolts and other anchoring devices, nuts, and washers shall be type 316 stainless steel if installed outside, below the top of walls of water containing structures, on the underside of roofs, slabs, or walkways, or on the dry side of walls on water containing structures.

### **2.03 Concrete Pedestals and Pads**

- A. Concrete pedestals and pad dimensions shall be provided with the equipment submittals. Minimum edge distance for anchors is 1.5 times the anchor embedment, but no less than 6". All conduits, piping connections, drains, etc., shall be enclosed by the concrete base.

### **2.04 Anchors and Adjustability**

- A. Post-installed epoxy and wedge anchors used in concrete for anchoring equipment shall be approved for cracked concrete per ACI 318 Appendix D, or specific Evaluation Report (ICC or IAPMO).
- B. See Drawings and equipment submittals for additional specific anchorage requirements.
- C. Provide leveling grout for equipment mounting unless otherwise detailed on Drawings or equipment submittals.
- D. Existing reinforcing bar may not be cut to install anchorage. Non destructive testing required to avoid existing reinforcing bar.
- E. Base plates may be slotted to provide flexibility in anchorage locations. Provide details of proposed slotting with submittal.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Equipment
  - 1. Except where a higher lateral force is required by code, each piece of equipment installed shall be anchored to resist a minimum lateral seismic load.
  - 2. No equipment shall be anchored to vertical structural elements without written approval of the Engineer.

3. Vibratory equipment shall be supported by isolator mounts to limit transmissibility to structure.

B. Piping

1. All piping, raceways, accessories, and appurtenances, furnished with equipment shall be anchored to resist a seismic force.

C. Anchor bolts

1. Care shall be taken to insure existing reinforcing bars are not damaged during drilling for or installation of anchors.

2. Prior to installing nuts on anchor bolts, coat with non-seize compound to prevent galling of threads.

3. Nuts shall be tightened to the torque specified by the manufacturer.

**\*\*END OF SECTION\*\***

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# SECTION 11060 ELECTRIC MOTORS

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This Section provides specifications for all electric motors furnished under this contract.
- B. Type: Motors specified herein are 3-phase, squirrel cage, 1/2 HP and above; or single phase types smaller than 1/2 HP.

### 1.02 References

- A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
IEEE 112	Standard Test Procedures for Polyphase Induction Motors and Generators
IEEE 841	Stand for Petroleum and Chemical Industry – Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors – Up to and including 500 HP
NEMA MG 1	Motors and Generators
NEMA MG 3	Sound Level Prediction for Installed Rotating Electrical Machines
NEMA MG 10	Energy Management Guide for selection and use of Polyphase Motors

### 1.03 Submittals

- A. The following material shall be submitted for each size and type of electric motor furnished under this contract:
  - 1. Manufacturer's name
  - 2. Manufacturer's type and frame designation
  - 3. Horsepower output
  - 4. Time rating
  - 5. Maximum ambient temperature rating
  - 6. Insulation system designation
  - 7. RPM at full load

8. Voltage, number of phases, frequency and full load amperes.
  9. Code letter for locked rotor KVA.
  10. Service factor at 40° C ambient.
  11. NEMA design letter.
  12. Enclosure type.
  13. Lubrication requirements, including type and frequency.
  14. KW input power and power factor at 50%, 75% and 100% of rated horsepower.
  15. Guaranteed minimum efficiency and nominal efficiency per MG1-12.55.
  16. Descriptive bulletins, including full description of insulation system.
  17. Manufacturer's connection diagrams for motors furnished with over temperature protectors, heaters, or other auxiliary devices.
  18. Sufficient data on over temperature devices verify required protection.
  19. Temperature rise at service factor horsepower.
- B. Provide installation, operation and maintenance instructions, and renewal parts list as required for maintenance manuals under Section 01300 - Submittals.

#### **1.04 Quality Assurance**

##### **A. Performance and Design Requirements**

1. General: The motors shall, in general, be premium quality high efficiency motors and shall be suitable for continuous duty operation.
2. Rating:
  - 1) Each motor shall develop ample torque for its required service throughout its acceleration range at impressed voltages in the range between 10 percent above and below nameplate rating. In addition, all motors shall be selected to be non-overloading at all points along the driven machines' full speed characteristic curves. Motors employed with variable frequency drives shall be suitable for inverter duty.
  - 2) Motors with a 1.0 service factor shall not be required to deliver more than 87 percent of rated nameplate horsepower under the specified loading conditions. Motors with 1.15 service factor shall not be required to deliver more than its rated nameplate horsepower under the specified loading condition.
3. Application:
  - 1) General: Motors supplied under this specification shall be, in general, be premium efficiency (P.E.) and premium quality suitable for continuous duty operation and, as indicated, for use with inverters (variable frequency drives) in a municipal wastewater pump station where ambient temperatures may range between 25 degrees F and 100 degrees F. Ambient relative humidity will range between 10 and 100 percent. The facility will be located at an elevation as indicated on the Hydraulic Profile and Design Data

Drawing of the Contract Documents. Details regarding environmental conditions for specific applications will be found in the detailed specifications for the driven equipment.

- 2) Enclosure Types: Enclosures shall be as defined by NEMA, and for the purpose of this specification shall be identified in the following manner:

<u>TYPE</u>	<u>ENCLOSURE</u>
A	OPEN DRIP PROOF (ODP)
B	TOTALLY ENCLOSED FAN COOLED (TEFC)
C	TOTALLY ENCLOSED NONVENTILATED (TE)
D	WEATHER PROTECTED NEMA TYPE II (WP-II)
E	EXPLOSION-PROOF
F	SUBMERSIBLE

- a) Unless noted otherwise, indoor horizontal motors shall be open, drip-proof.
- b) Unless noted otherwise, indoor vertical motors shall be open, drip-proof with guard.
- c) Unless noted otherwise, outdoor horizontal shall be totally enclosed fan cooled.
- d) Unless noted otherwise, outdoor vertical shall be weather protected.

- 3) Application Types:

<u>TYPE</u>	<u>APPLICATION</u>
I.	Process motors
II.	Non-process motors
III.	Process motors (same as Type I) except with low noise levels
IV.	Non-process motors (same as Type II) except with low noise levels

- a) Unless noted otherwise, all motors in these specifications shall be Type I (process motors). Type I motors shall be employed for the operation of all process-related equipment, equipment mounted below grade and all ventilation equipment serving process equipment areas.
- b) Unless otherwise specified, Type II (non-process) motors are those driving heating and ventilating equipment located above grade and servicing non-process related areas, equipment with "built-in" or integral construction motors; and fractional horsepower motors below 1/2 HP.
- c) Unless otherwise specified, Type III motors shall meet the specifications for Type I motors (process) and have additional special low noise level requirements.
- d) Type IV motors shall meet the specifications for Type II motors (non-process) and have additional special low noise level requirements.

### **1.05 Delivery, Storage, and Handling**

- A. Comply with Section 01620 – Protection of Materials and Equipment.

## **1.06 Project / Site Conditions**

A. Refer to individual equipment sections and drawings for installation locations.

## **1.07 Sequencing and Scheduling (Not Used)**

## **1.08 Warranty**

A. Provide two year warranty from date of substantial completion unless manufacturer's standard warranty is longer.

## **1.09 Maintenance**

A. Comply with Section 01360 – Operating and Maintenance Information.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

A. The below listed manufacturer's motors generally meet the class and performance requirements of this specification when furnished with appropriate modifications and additional features as specified.

#### **B. Horizontal Motors**

1. Type 1 and 2 – Premium efficiency motors manufactured by General Electric Inc., Type KS; and Reliance Electric Co., Type XEX, or equal.
2. Type 3 – Premium efficiency explosion-proof motors manufactured by General Electric Inc., Type KS, Class I, Group D; and Emerson US Motors, Type LCE; or equal.

#### **C. Vertical Motors**

1. Type 1 and 2 – Premium efficiency motors manufactured by General Electric, Inc., Type KS; and Emerson US Motors, Type TUCE Corroduty, or equal.
2. Type 3 – Premium efficiency explosion-proof motors manufactured by General Electric Inc., Type KS, Class I, Group D and Emerson US Motors, Type LUCE, or equal.

#### **D. Inverter Duty Motors**

1. Baldor, Inverter Motor; General Electric, ASD; Reliance, RPM-AC (XT); and Emerson US Motors, Varidyne Inverter Duty, or equal.

### **2.02 Equipment and Materials**

#### **A. General**

1. Open drip proof motors shall have openings constructed so that falling liquids or solid particles striking or entering the enclosure at any angle from 0 to 15 degrees from vertical will not interfere with the performance.
2. Totally enclosed fan cooled and totally enclosed non-ventilated motors shall be provided with drilled and tapped holes to drain all cavities within the motor. Motors with frames 286T or smaller and with frame 324T or larger shall be provided with automatic breather-drain devices.
3. Weather protected NEMA Type II (WP-II) motors shall be provided with screens to prevent objects larger than 1/2 inch from entering the enclosure. If weather-protected NEMA Type II enclosures cannot be supplied for the required frame sizes, subtypes B or C motor enclosures may be substituted.

4. Explosion-proof motors shall be UL listed for Class I, Division 1 Group D hazardous locations and be provided with UL approved combination breather drains suitable for hazardous locations.
5. Submersible motors shall be watertight and supplied with a continuous flexible electrical cable of the correct capacity of sufficient length to reach the junction box shown.
6. Heaters shall be provided to prevent moisture condensation after shutdown on all motors where specified. Heaters shall be cartridge type or flexible wrap-around type installed adjacent to core iron. Heaters shall be rated 120 volts, single phase, and rating in watts and volts shall be noted on a motor nameplate or a second nameplate. The space heater terminals shall be brought to a separate terminal in the box.
7. The motor manufacturer's nameplates shall be engraved or stamped on stainless steel and fastened to the motor frame with No. 4 or larger oval head stainless steel screws or drive pins. Nameplates shall indicate clearly all the items of information enumerated in NEMA Standards MG1-10.37, MG1-10.38, or MG1-20.60, as applicable.
8. The nameplate shall be positioned to be readily visible for inspection in the complete machine.

**B. Three Phase Motors - 1/2 Through 250 Horsepower**

1. General: All motors 1/2 HP through 250 HP shall be 3 phase, squirrel cage, induction motors on NEMA frame 143T or larger. Type A motors shall be open drip proof motors with modification to obtain premium quality motors. Types B, C, and D motors shall be of the type generally designated by Westinghouse as "Mill and Chemical," by Reliance as "Model XT," or equal. Conductors shall be copper.
2. Rating: Motors shall be designed for 230/460 volt, 3 phase, 60 Hz operation. All leads shall be brought to the motor terminal box for reconnection as required. Motors shall be reconnected for voltage as shown on the electrical drawings. All motors shall have a 1.15 continuous duty service factor at 50 degrees C ambient temperature and shall be suitable for 65 degrees C ambient with a 1.0 service factor, unless noted otherwise. Starting kVA/HP shall not exceed the values given in NEMA Standard MG1-12.34. The motors shall be suitable for operation in either direction (clockwise or counterclockwise) of rotation.
3. Insulation: Motor rating shall be based on Class B, 80 degrees C, temperature rise above an ambient of 40 degrees C. Insulation systems shall be NEMA Class F, non-hygroscopic, and shall be suitable for use in moisture-laden atmospheres and atmospheres containing acid or alkali vapor. Insulation systems shall be manufacturer's premium grade, capable of withstanding contaminated atmospheres.
4. Current Balance:
  - a. Motor current unbalance on poly-phase motors shall not exceed the values tabulated below when motor is operating at any load within its service factor rating and is supplied by a balanced voltage system:

<u>Horsepower Rating</u>	<u>Motor Current Unbalance</u>
Under 5 horsepower	25 percent
5 horsepower and above	10 percent

- b. If, however, the unbalanced currents cause mechanical vibrations, the Contractor shall correct the problem even if the measured unbalance is less than listed above.
5. Over temperature Protection:

- a. Winding over temperature devices shall be provided for all motors rated 50 horsepower and larger, for all Type E (explosion-proof) motors, and for all other motors where specified.

<u>Motor Type</u>	<u>Thermal Protection</u>	
	<u>Type 2 - Thermostats</u>	<u>Type 1 – RTDs</u>
Non-Inverter duty	50-150 HP	175-250 HP
Inverter duty	1- 60 HP	75-250 HP

- b. Provide thermal protection in each stator winding
    - 1) Thermostats: Bimetallic switch type, self-resetting.
    - 2) Resistance temperature detectors (RTDs): 100-ohm platinum type (two per phase).
  - c. Over temperature devices shall provide a normally closed contact suitable for wiring into the motor control circuit. Any relays or solid state contacts which are required shall be provided in an enclosure on or near the motor. These enclosures shall be NEMA 12 for Type A motors, NEMA 4 for Type B, C, or D motors, NEMA 7D for Type E, and NEMA 4X for Type F motors
6. Enclosures:
- a. All motors shall have cast iron housing, bearing brackets, fan guard and conduit box. Open drip proof and totally enclosed motors shall be furnished with silicon rubber gaskets at the base of the conduit box and between the halves of the motor terminal box.
  - b. All motors shall be provided with a pad with a drilled and tapped hole, not less than 1/4 inch diameter, inside the conduit box for a motor frame grounding stud.
  - c. Motors weighing more than 50 pounds shall be equipped with two lifting eyes. All hardware shall be corrosion-resistant. Motors shall be delivered with the manufacturer's standard epoxy enamel finish.
7. Reduced Voltage Starting: Where shown on the drawings, motors [50] [125] HP and larger shall be suitable for reduced voltage starting using solid state or autotransformer starting.
8. Bearings: Three-phase motor bearings shall be conservatively designed to withstand all stresses of the service specified. Antifriction motor bearings shall be designed to be re-greasable and initially shall be filled with grease suitable for ambient temperatures to 60 degrees C. If a higher ambient temperature is specified for motor insulation rating purposes, bearings shall be sized and designed for the same ambient. Bearing identification by AFBMA number shall be indicated on the motor nameplate.
9. Efficiency: NEMA Premium Efficiency 4-Pole motors rated 600 volts or less shall have the following full load efficiencies:

<u>Motor HP</u>	<u>ODP Nominal Efficiency</u>	<u>TEFC Nominal Efficiency</u>
1	85.5	85.5
1.5	86.5	86.5
2	86.5	86.5
3	89.5	89.5

<u>Motor HP</u>	<u>ODP Nominal Efficiency</u>	<u>TEFC Nominal Efficiency</u>
5	89.5	89.5
7.5	91.0	91.7
10	91.7	91.7
15	93.0	92.4
20	93.0	93.0
25	93.6	93.6
30	94.1	93.6
40	94.1	94.1
50	94.5	94.5
60	95.0	95.0
75	95.0	94.4
100	95.4	95.4
125	95.4	95.4
150	95.8	95.8
200	95.8	96.2
250	95.8	96.2
300	95.8	96.2
350	95.8	96.2
400	95.8	96.2
450	96.2	96.2
500	96.2	96.2

### C. Single-phase Motors

#### 1. General:

- a. Unless otherwise specified, single-phase motors shall be capacitor-start induction motors. Small single-phase fan motors may be split-phase or shaded-pole type, if such is standard for the equipment. Universal (AC-DC) type single-phase motors are not acceptable unless their specific characteristics are necessary for the application. Conductors shall be copper.
- b. Single-phase motors shall be designed and connected for operation on a 115 volt, 60 Hz alternating current electrical system, or 208 volt where indicated.

#### 2. Rating:

- a. Unless otherwise specified, single-phase motors shall not be required to deliver more than its rated nameplate horsepower under any condition of required loading. Type IB and IIB single-phase motors shall be continuous-time rated in conformity with NEMA Standard MG1-10.35.
- b. Single-phase motor locked rotor current shall not be greater than that specified in NEMA Standard MG1-12.32, Design "N."

3. Enclosures: Unless otherwise specified, single-phase motors shall be Type IB or IIB. Small single-phase fan motors may have open-type enclosures if they are suitably protected from moisture, dripping water and lint buildup.
  - a. Explosion Proof Motors:
    - 1) Furnish with UL label for Class I, Division 1, Group D hazardous locations.
    - 2) Provide an over-temperature device in the enclosure to detect and automatically de-energize the motor if the enclosure surface temperature exceeds 260° C.
    - 3) Mark nameplate with UL frame temperature limit code T2B.
4. Insulation: Unless otherwise specified, single-phase motor insulation systems shall be as recommended by the motor manufacturer.
5. Construction: Unless otherwise specified, single-phase motor construction shall be as recommended by the motor manufacturer.
6. Bearings: Unless otherwise specified, single-phase motors shall be provided with sealed ball bearings lubricated for 10 years normal use

### **2.03 Components and Accessories**

- A. Lifting Eyes: Fit all motors weighing more than 50 pounds with two lifting eyes.
- B. Space Heaters:
  1. Where specified, size and design to prevent condensation inside the motor enclosure after shutdown.
  2. Type: Cartridge or flexible wraparound type.
  3. Power Requirements: 120 volts, single phase, 60 Hz.
  4. Mark the ratings in watts and volts on the motor nameplate or on a second nameplate.
  5. Bring terminals to a separate terminal block or to pigtails in the conduit box.

### **2.04 Fabrication**

- A. Outdoor motors shall have the following features:
  1. Bearing protection.
  2. Anti-corrosion treatment of external hardware and internal metal parts.
  3. Weatherproof terminal box with gaskets between the motor, terminal box and terminal box cover.
  4. Guard screen on ventilation openings.
  5. Moderate moisture resistant insulation.
  6. Interior and exterior corrosion protection coatings.
- B. Severe duty motors shall have the following features:
  1. Totally enclosed, fan cooled enclosure.
  2. Stainless steel nameplate.
  3. Cast Iron Housing, bearing brackets and fan guard.
  4. Cast Iron conduit box with threaded conduit entrance.
  5. Corrosion resistant fan.

6. Corrosion resistant hardware.
  7. Automatic breather/drain.
  8. Ground lug.
  9. Regreasable bearings.
  10. Provision for excluding water and dust from bearings.
  11. Class F insulation.
  12. Epoxy coating on all external surfaces.
- C. Submersible motors shall have the following features:
1. Air filled or oil filled squirrel cage induction type.
  2. Service factor of 1.15 or better.
  3. Class F insulation, Class B temperature rise.
  4. Rated for 6 starts per hour unless a greater number is allowed in the equipment specification.
  5. Listed for Class 1, Division 1, Groups C and D hazardous locations.
  6. If required by the manufacturer to not void the motor warranty, provide a moisture detection system and a motor winding thermostat system. These systems shall be complete, including all necessary interfaces, control panels, conduits and wires.

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. Motors shall be tested for correct rotation during pre-operational checkout.

### **3.02 Installation**

- A. Motors, when factory installed, shall be aligned and connected to driven equipment, common bases, stands, etc., with the driven equipment. Suitable couplings and guards shall be provided between motor and driven equipment. Personal guards shall be provided over all shafts, couplings, or other exposed moving parts.
- B. Install motors in driven equipment in conformance with motor manufacturer's recommendations and requirements. Motor nameplate shall be visible when installed on the driven equipment.

### **3.03 Field Quality Control**

- A. The Contractor shall provide services of an experienced, competent and authorized representative of manufacturer to visit site of work and inspect, check, adjust if necessary, and approve equipment installation for motors. The equipment Manufacturer's Representative shall be present when equipment is place in operation.
- B. The equipment Representative shall revisit the job site, to correct any equipment installation and operational problems. The Representative shall provide service until all conditions are, in the opinion of the Engineer, satisfactory.
- C. The Contractor shall verify that all motor overcurrent protection is in accordance with NEC.
- D. Performance Tests:
1. General: Should any motor exhibit indication of questionable performance, the Inspector, may request information or load test at any time after delivery of a motor to the job site. If any

motor proves to be defective, all costs of testing and repair or replacement of defective motor shall be borne by the Contractor. If any motor proves to be in accordance with recommendations or manufacturer's tolerances, the cost of testing will be borne by the Agency.

2. Insulation: Insulation resistance tests shall be performed by the Contractor. Tests for acceptability shall be made using a 1000-volt megohm meter (megger). Interpretations of test results for minimum acceptable values of insulation resistance will be made in accordance with IEEE Publication 43.
3. Load Testing: Load tests shall be performed to determine the motor's ability to meet service factor loading conditions within the temperature limits of the manufacturer's submittal data. Tests shall be conducted in accordance with IEEE Publication 112A. In the event that a motor does not meet the load test requirements, the Contractor shall replace the motor at no cost.

**\*\*END OF SECTION\*\***

## SECTION 11070 EQUIPMENT INSTALLATION, TESTING, AND STARTUP

### PART 1 - GENERAL

#### 1.01 Summary

- A. In accordance with Section 01660, this Section provides specifications for the installation, testing, and startup of all mechanical and electrical systems and processes. Additional testing requirements for equipment, piping, structures, instrumentation, control, and electrical systems are included in other Sections. All installation and testing work for the equipment and unit processes installed under this Contract shall be performed by the Contractor.
- B. Contractor to coordinate requirements of this specification with additional testing required elsewhere including but not necessarily limited to Section 02667 - Hydraulic Testing of Structures and Section 17512 – Site Acceptance Testing.
- C. General Timeline for equipment testing and startup:
  - 1. Manufacturer's equipment installation acceptance (Manufacturer's Checkout) for a unit process or group of processes,
  - 2. Contractors' equipment and supporting system acceptance (Functional Checkout) for a unit process or group of unit processes,
  - 3. Clean Water, Raw Water or air testing, by Contractor (Performance Test), for a unit process or group of unit processes, and then
  - 4. Operation of a unit process or group of unit processes through the Demonstration Period by the City in support and coordination with the Contractor.
- D. Successful testing or demonstration of a unit processes in one portion of the plant may be required by the construction constraints before modifications to other portions of the plant may be initiated. Contractor is responsible for planning and coordinating all testing and demonstrations.

#### 1.02 Definitions

- A. Facility: Entire project or agreed upon portion including all unit processes.
- B. Unit Process: A portion of the facility that performs a specific process function.
- C. Manufacturer's Checkout(s): Checkout(s) and test(s) on individual pieces of equipment by the equipment manufacturer under the Contractor's supervision to demonstrate that installed equipment meets the manufacturer's installation, calibration, and adjustment requirements. At a minimum all equipment specified in the Division 11 specifications shall be considered major equipment and shall undergo a detailed Manufacturer's Checkout.
- D. Functional Checkouts: Checkout(s) and test(s) on groups or individual pieces of equipment by Contractor to demonstrate that installed equipment meets a) manufacturer's installation, calibration, and adjustment requirements; b) electrical and control system requirements as defined elsewhere including the Site Acceptance Test (SAT) requirements of Section 17512; and c) all other requirements as specified. At a minimum all equipment specified in the Division 11 specifications shall be considered major equipment and shall undergo a detailed Functional Checkout.
- E. Performance Tests: Test(s) of a unit process or group of unit processes conducted by the Contractor with clean water to demonstrate that the system(s), including equipment, instrumentation, controls, electrical, and auxiliary components function to meet the requirements of a) manufacturer's installation, calibration, and adjustment requirements; b) electrical and control

system requirements as defined in the Site Acceptance Test (SAT) requirements; and c) all other requirements as specified.

1. Duration of Performance Testing: Continuous Period, 24 hours per day, duration as specified in Section 01660. If longer periods are required to fully test all portions of the system including but not limited to the instrumentation and control system testing then the Contractor shall identify this additional time in the required Plans and include additional testing at no additional costs to the Owner.
2. Performance Testing may not begin until all equipment within the planned test have successfully completed individual Functional Checkouts.
3. Performance Testing with clean water is sometimes impractical in an operating wastewater plant. The minimum project specific Performance Testing requirements shall be as indicated in section 3.05 below.

F. Demonstration Period(s): Period(s) of initial operation and shakedown of a unit process or group of unit processes by the Plant Operations Staff after successful Functional Checkout, Performance Testing, and initial Site Acceptance Testing (SAT) of the facility or portion of a facility. Demonstration Periods shall be used to further demonstrate facility operation under actual loading conditions and to identify issues not readily apparent or discovered during previous testing.

1. Duration of each Demonstration Period: Continuous Period, 24 hours per day, duration as specified in Section 01660.
2. Equipment O&M manuals for all equipment within the unit process to be demonstrated shall be delivered to the Operations Staff at least two weeks prior to the initiation of a Demonstration Period. A Demonstration Period may not begin until the Operations Staff has had at least two weeks to review and study the equipment O&M manuals.
3. Individual equipment warrantee periods shall not begin prior to the completion of a successful Demonstration Period.
4. A unit process may not be relied upon for wastewater treatment until said unit process has successfully completed a Demonstration Period. The Contractor shall incorporate this constraint into the overall project construction schedule.
5. If a deficiency is found, the Contractor shall stop the Demonstration Period and correct the deficiency(s). The Demonstration Period shall then be reinitiated the demonstration until the full period of demonstration has been completed and accepted by the Owner's Representative.

### **1.03 General**

A. Installation:

1. All mechanical and electrical equipment furnished under this contract shall be installed in conformity with the details shown and specified and to the manufacturer's requirements.
2. Should a manufacturer's installation requirements conflict with specific requirements of the contract documents, the Contractor shall bring the matter to the attention of the Construction Manager for resolution.
3. Any additional costs incurred arising out of changes authorized by the Construction Manager to accommodate manufacturer's installation requirements shall not be considered extra work.
4. Any costs, or time, incurred by the Contractor through failure to timely notify the Construction Manager of a difference between contract documents and manufacturer's installation requirements shall be borne by the Contractor.

B. Testing:

1. General Requirements:
  - a. All materials, equipment, and work included in this contract shall be tested and inspected to insure compliance with the contract requirements.
  - b. Unless otherwise specified, all costs of testing, including temporary facilities and connections, shall be borne by the Contractor.
  - c. For the purpose of this section, equipment shall mean any mechanical, electrical, instrumentation, or other device with one or more moving parts or devices requiring an electrical, pneumatic or hydraulic connection. Installed tests for equipment, piping, structures, instrumentation, control, and electrical systems are also included in other Sections.
2. No tests specified herein shall be applied until the item to be tested has been inspected and approval by the Construction Manager.
3. Tests and inspections, unless otherwise specified or accepted, shall be in accordance with the recognized standards of the industry.
4. The form of evidence of satisfactory fulfillment of all test and inspection requirements shall be, at the discretion of the Engineer, either by tests and inspections carried out in the Construction Manager's presence or by certificates or reports of tests and inspections carried out by approved persons or organizations.
5. The Contractor shall provide and use forms which include all test information, including specified operational parameters, and which shall be acceptable in content to the Construction Manager.

#### **1.04 Submittals**

##### **A. General**

1. Details of the procedures for testing and startup of all equipment to be operated singly and/or together as a unit process, excepting when such procedures have been covered in the specifications, shall be submitted as part of the required plans.
2. The procedures shall be divided into three distinct stages; Functional Checkouts, Performance Tests, and Demonstration Periods.
3. Testing procedures shall be designed to duplicate, as nearly as possible, all conditions of operation and shall be carefully selected to ensure that the equipment is not damaged.

##### **B. Testing and Startup Plans:**

1. In addition to the testing requirements of Section 17512, testing and startup plans of each piece of major equipment or unit process shall be detailed within the following plans:
  - a. Functional Checkout Plan
  - b. Performance Test Plan
  - c. Demonstration Period Plan
2. Plan shall describe all procedures and the associated schedule constraints for all activities from Functional Checkout through the Demonstration Period.
3. Plans shall include checkout, alignment, adjustment and calibration sign-off forms for each piece of major equipment. These forms will be used in the field by the Contractor and the Construction Manager jointly to ensure that each item of control, electrical, and mechanical equipment has been properly installed, calibrated, and tested.

4. Plans shall include blank test logs for each item of equipment and each unit processes to be tested.
5. Plans shall be submitted no less than 30 days prior to beginning activities.
6. Contractor shall provide weekly updates of the testing and startup activities including a 14 day look-ahead schedule.

C. Reports:

1. Submit certification of calibration of all instrumentation, including testing equipment before the Performance Test.
2. Submit written reports of:
  - a. Completed and signed Functional Checkouts
  - b. Completed and signed Performance Test logs
  - c. Completed and signed Demonstration Period logs

**1.05 Manufacturer's Checkout and Certification**

A. Field Services:

1. Manufacturer's representatives shall inspect and certify that equipment has been correctly installed and is ready for start-up.
2. To the extent possible field tests shall be made by the Contractor and the manufacturer's representative in the presence of the Construction Manager to demonstrate that under all conditions of operation each unit:
  - a. Has not been damaged by transportation or installation
  - b. Has been properly installed
  - c. Has no mechanical defects
  - d. Is in proper alignment
  - e. Has been properly connected
  - f. Is free of overheating of any parts
  - g. Is free of all objectionable vibration
  - h. Is free of excessive noise
  - i. Is free of overloading of any parts
  - j. Shall operate as specified with the control system
  - k. Meets the performance requirements indicated
3. Any defects in the equipment or failure to meet the requirements of the Specifications shall be promptly corrected by the Contractor.

B. Manufacturer's Certification:

1. The Contractor shall submit a written certification letter produced by the manufacturer's representative for each piece of equipment to illustrate acceptance of installation and readiness for operation of each unit.
2. Each letter shall be submitted on the manufacturer's letterhead and shall include the following statements that:

- a. The signer has visited the site, inspected the equipment and installation, and certifies that the equipment is ready for operation.
- b. The equipment has been installed in accordance with the manufacturer's requirements and is properly aligned and ready for operation.
- c. The equipment has been serviced, lubricated and properly prepared to perform in accordance with the intent of the Contract Documents.
- d. The controls, protective devices, instrumentation, and control panels furnished, as part of the equipment package, are properly installed, calibrated, and are ready for full time operation.
- e. The control logic for startup, shutdown, sequencing, interlocks, remote operation, and emergency shutdown have been tested to the extent possible and are functioning properly.
- f. The training of the Owner's operations and maintenance personnel has been completed and note the date and time of that training.
- g. The manufacturer certifies that the equipment is approved for operation.

## **1.06 Contractor's Functional Checkouts**

### **A. General:**

1. All equipment and unit process shall be inspected and certified per the Functional Checkout Plan by the Contractor.
2. Tests shall be as specified herein and as recommended by the manufacturer to illustrate that the equipment has been properly assembled, aligned, adjusted and connected.
3. Any changes, adjustments or replacements required to make the equipment operate as specified shall be carried out by the Contractor as part of the Work.
4. The Functional Checkout procedures shall incorporate all requirements of these specifications and shall proceed in a logical, step-wise sequence to ensure that all equipment has been properly serviced, aligned, connected, calibrated, and adjusted in preparation to initial operation.

### **B. Checkout results shall be within the tolerances set forth in the detailed specification sections of the contract documents and any manufacturer's required specifications.**

1. If no tolerances have been specified, results shall conform to tolerances established by recognized industry practice.
2. Where, in the case of an otherwise satisfactory result, any doubt, dispute, or difference should arise between the Construction Manager and the Contractor regarding the results or the methods or equipment used in the performance of such checkout, the Construction Manager may order the checkout to be repeated.
3. If the repeat tests, using such modified methods or equipment as the Construction Manager may require, substantially confirms the previous results, then all costs in connection with the repeat test will be paid by the Owner; otherwise the costs shall be borne by the Contractor.
4. Where the results of any installed test fail to comply with the contract requirements for such test, then such repeat tests as may be necessary to achieve the contract requirements shall be made by and at the expense of the Contractor

### **C. Functional Checkout shall include, but not necessarily be limited to:**

1. Electrical system testing.
2. Instrumentation and controls testing.

3. Piping system pressure testing and cleaning.
  4. Alignment of equipment.
  5. Lubrication of equipment.
  6. Cleaning of tanks, channels, basins, and all structures.
- D. At a minimum the following data shall be collected and documented on forms:
1. Operating voltages and amperages per phase.
  2. Motor inrush current.
  3. Operating pressures.
  4. Operating flows.
  5. Equipment operating temperatures.
  6. Analog inputs and outputs during test.
  7. Analytical instruments outputs during test.
  8. Alarm conditions.
- E. Records and Forms:
1. The Contractor shall provide signoff forms for all checkouts and testing to be accomplished under this contract as part of the Functional Checkout Plan.
  2. Written certification by the Contractor shall show that the equipment and associated systems have been installed in accordance with a) equipment manufacturer's installation, calibration, and adjustment requirements; b) electrical and control system requirements as defined in the Site Acceptance Test (SAT) requirements; and c) all other requirements as specified and that the Owner's staff is suitably instructed in operation and maintenance of the equipment.
  3. Sign off forms shall be provided for each major item of mechanical, electrical and instrumentation equipment provided or installed under this contract and shall contain provisions for recording relevant performance data for original testing and not less than three retests.

## **1.07 Performance Tests**

### **A. General**

1. Performance Tests shall demonstrate that each unit process including, piping, valves, gates, controls, instrumentation, and auxiliary systems functions as intended with air, "clean" water, or actual, pre-treated, raw water (or wastewater).
2. All systems and components shall be operated as a complete facility at various flow conditions, as directed by the Construction Manager.
3. All equipment and systems shall be operated, to the greatest extent practicable, at conditions which represent the full range of operating parameters as defined by the Contract Documents.
4. The equipment shall be operated to determine equipment operating characteristics, including temperatures and vibration; to observe performance characteristics; and to permit adjustment of operating controls.
5. Performance Tests shall include remote PLC modes of operation, alarms, and shutdowns as required of the electrical, instrumentation and controls by the Site Acceptance Testing.
6. All gratings, safety chains, handrails, shaft guards, walkways and sidewalks must be installed prior to Performance Testing.

7. All lighting, heating, ventilation, and air conditioning equipment for areas and processes to be included in the Performance Test must be operational prior to Performance Testing.

#### B. Performance Test Sequencing

1. Performance testing may commence only after submission and acceptance of Functional Checkout documentation.
2. Contractor shall notify the Owner 14 days prior to the start date of a Performance Test.
3. Contractor shall inspect and clean debris and dirt from all piping and structures prior to testing.
4. Contractor shall fill all process units and liquid process systems, except those employing oil or chemicals, with disinfected secondary effluent to allow testing.
  - a. Unless otherwise specified, the Contractor shall provide at no expense to the Owner, all power, fuel, water, utilities, supplies, consumables, chemicals, testing media, labor and all other necessary items and work required to complete all tests specified in this section.
  - b. Coordinate with Construction Manager for supply of test water.
  - c. Test media for chemical systems shall be either the intended fluid or compatible substitute, as directed by the Construction Manager.
  - d. Disposal methods for test media shall be subject to review by the Construction Manager.
  - e. Contractor shall be responsible for costs for disposal of test media.

#### C. Performance Test Criteria

1. The Performance Testing shall be deemed successful if the unit process performs within limits of requirements of these Contract Documents without failures or alarms due to mechanical, electrical, or instrumentation installation or other miscellaneous inadequacies.
2. Should a Performance Test period be halted for any reason related to the facilities constructed or the equipment furnished under this contract, or the Contractor's temporary testing systems, the Performance Test program shall be repeated until the specified continuous period has been accomplished without interruption.
3. If, under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed or replaced; tests on that portion when so adjusted, altered, removed or replaced, together with all other portions of the work as are affected thereby, shall be repeated within reasonable time and in accordance with the specified conditions.
  - a. The Contractor shall pay to the Owner all reasonable expenses incurred by the Owner as a result of repeating such tests.
4. At the conclusion of each Performance Test, the Contractor shall recheck all equipment for proper alignment, and if necessary, realign the equipment to manufacturer's standards or Contract requirements.
  - a. All equipment shall be checked for loose connections, unusual movement or other indications of improper operating characteristics.
  - b. Any deficiencies shall be corrected to the satisfaction of the Construction Manager.
  - c. All equipment or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected.
  - d. Unacceptable equipment shall then be repaired or removed from the site and replaced at no cost to the Owner.
5. Written certification by the Contractor shall be submitted to show that the equipment and associated systems were able to perform with clean water in accordance with a) equipment

manufacturer's installation, calibration, and adjustment requirements; b) electrical and control system requirements as defined in the Site Acceptance Test (SAT) requirements; and c) all other requirements as specified.

## **1.08 Demonstration Periods:**

### **A. General:**

1. During any Demonstration Period, the Operations Staff will operate the facility with the assistance and coordination from the Contractor.
2. A Demonstration Period shall commence when, in the opinion of the Construction Manager, the following conditions have been met:
  - a. All related equipment Functional Checkouts are complete and documentation has been received by Owner's Representative.
  - b. All related Performance Testing is complete and documentation has been received by Owner's Representative.
  - c. All Operations and Maintenance Manuals have been submitted, approved and copies have been transmitted to the Owner's operations staff.
  - d. All Operations & Maintenance training is complete.
  - e. All Manufacturer Certifications have been submitted.
3. Contractor shall schedule and notify the Owner 30 days prior to the start date of a Demonstration Period.
4. Contractor shall schedule process cut-overs or tie-ins with the Owner's Representative and Owner's Operations Staff.
5. Contractor shall make available its personnel, subcontractors, suppliers, and manufacturers representatives for each Demonstration Period.
  - a. Contractor personnel shall be onsite during normal working hours for the entire period to make necessary corrections and adjustments.
  - b. Contractor's electricians or electrical subcontractor shall be onsite during normal working hours for the entire period to make necessary corrections and adjustments.
  - c. SCADA and controls integrator shall be available to be onsite within 48 hours during the entire period to make corrections, modifications, and updates to the control system.
  - d. All other subcontractors, suppliers and manufacturer's representatives shall be available to be onsite within 48 hours during the entire period to make necessary corrections and adjustments.
6. Contractor shall provide emergency contact numbers to be available 24 hours/day during each Demonstration Period.

### **B. Owner shall furnish:**

1. Operations Staff to operate the facility with support of Contractor.
2. Labor and materials required for laboratory testing.

### **C. At the end of the final Demonstration Period, the Owner may issue a Substantial Completion Certificate, if in the opinion of the Construction Manager, the following conditions have been met:**

1. Corrections or adjustment to the facility as required by the Owner, Construction Manager or Engineer to assure a reliable and completely operational facility have been made.
2. All test reports have been submitted, reviewed, and accepted as adequate.

3. All other Contract requirements for Substantial Completion have been fulfilled by the Contractor to the satisfaction of the Owner, Construction Manager, and Engineer.

## **PART 2 - PRODUCTS**

### **2.01 Materials**

#### **A. Gages, Meters, Recorders and Monitors:**

1. Gages, meters, recorders and monitors shall be provided by the Contractor as required to supplement or augment the instrumentation system provided under this contract to properly demonstrate that all equipment fully satisfies the requirements of the contract documents.
2. All devices employed for the purpose of measuring the performance of the equipment and unit process shall be specifically selected to provide a level of certainty consistent with the variables to be monitored.
3. All instruments shall be calibrated, and the Contractor shall be prepared at all times to demonstrate, through recalibration, the certainty of all instruments employed for testing purposes.
4. Calibration procedures shall in accordance with manufacturer's written instructions and applicable standards of ASTM, ISA and IEEE.
5. The adequacy of all gages, meters, recorders and monitors shall be subject to review of the Owner's Representative.

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. Inspect and clean the equipment, connected piping and structures and remove debris and foreign material. Flush piping. Sweep or vacuum clean all channels and structures to remove fine material.
- B. Turn rotating equipment by hand to check for binding or other improper operation.
- C. Perform cold and hot alignment to the manufacturer's recommended tolerances.
- D. Remove rust preventatives, oils or temporary protective coatings used to protect the equipment during construction.
- E. Open and close adjacent valves by hand to check for proper seating and range of motion.
- F. Electrical systems:
  1. Complete insulation resistance tests on wiring.
  2. Perform grounding tests as required.
  3. Complete motor insulation resistance tests.
  4. Verify correct rotation of motors and equipment.
  5. Complete other requirements per electrical specifications.
- G. Instrumentation systems:
  1. Complete instrument calibration.
  2. Complete instrument loop tests.

3. Verify all control signals, operation, ranges, alarms, and settings.
4. Complete other requirements per instrumentation and controls specifications.

**3.02 Installation:**

- A. All materials and equipment shall be installed by specialists properly skilled in the trades and professions required to assure first-class workmanship.
- B. Where required by detailed specifications, the Contractor shall cause the installation of specific equipment items to be accomplished under the supervision of factory-trained installation specialists furnished by the equipment manufacturers.
- C. The Contractor shall be prepared to document the skills and training of all workers engaged in the installation of all equipment furnished either by the Contractor or the Owner.

**3.03 Testing and Startup:**

- A. Testing and startup shall proceed on a step-by-step basis in accordance with the Contractor's written plans.
- B. The Contractor's testing work shall be accomplished by a skilled team of specialists under the direction of a coordinator whose sole responsibility shall be the orderly, systematic testing of all equipment, systems, structures and the complete facility as a unit.
- C. Each individual step in the procedures shall be witnessed by the Construction Manager or Inspector.

**3.04 Project Specific Functional Checkout Schedule**

- A. At a minimum Functional Checkout will be required on the following equipment and each equipment's controlling electrical/Instrumentation Systems, per specification sections 01660, 11070, & 17512. This table has been prepared to itemize the minimum requirements for equipment testing and does not negate or supersede requirements elsewhere in these specifications.

<b>Tag No</b>	<b>Descriptions</b>	<b>Minimum Performance Criteria</b>
MOV-220, MOV-230	Secondary Flow Control Pinch Valves	Per Section 15145
MX-640	Vertical Turbine Mixer	Per Section 11100
P-330, P-340	Reciprocating Positive Displacement Pumps	Per Section 11300
M-320	Circular Clarifier Equipment	Per Section 11352
P-370	Effluent Vertical Turbine Pump	Per Section 11400
MOV-331	RAS On/Off Control Plug Valve	Per Section 15145
MOV-332	WAS On/Off Control Plug Valve	Per Section 15145
B-610, B-620	Blowers	Per Section 11415
MOV-631, MOV-641	Digester Telescoping Valve	Per Section 15145

- B. Coordinate Functional Checkout with water tightness testing as specified in Section 02667 - Testing of Hydraulic Structures.

C. Coordinate Functional Checkout with control system testing as specified in Section 17512 - Site Acceptance Testing.

### **3.05 Project Specific Performance Tests and Demonstration Periods**

A. At a minimum system Performance Tests shall be, but not limited to, conducted for the following unit processes, per individual Technical Specification Sections.

1. Secondary Flow Control Pinch Valves
2. Secondary Clarifier
3. RAS/WAS Pump Pumps
4. Secondary Clarifier 2 - Effluent Pump Station
5. Chemical Feed Systems
6. Aerobic Digester
7. Standby Generator

B. At a minimum system Demonstration Periods shall be conducted for the following unit processes under actual operating conditions.

1. Secondary Flow Control Pinch Valves
2. Secondary Clarifier
3. RAS/WAS Pump Pumps
4. Secondary Clarifier 2 - Effluent Pump Station
5. Chemical Feed Systems
6. Aerobic Digester
7. Standby Generator

C. Coordinate Testing and Demonstration Periods with control system testing as specified in Section 17512 - Site Acceptance Testing.

**\*\*END OF SECTION\*\***

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**SECTION 11100  
VERTICAL TURBINE MIXERS**

**PART 1 - GENERAL**

**1.01 Summary**

A. This section specifies constant speed vertical turbine mixers for the aerobic digesters.

**1.02 System Description**

A. Equipment Tag Numbers:

<u>Tag Number</u>	<u>Service</u>	<u>Drawing Reference</u>
MX-630	Vertical Turbine Mixer – Digester #3	I004
MX-640	Vertical Turbine Mixer – Digester #4	I004

- B. Each aerobic mixer shall include supply of motor, reducer, mounting system, coupling, shaft assembly, and impeller.
- C. The mixer shall be removable from the top of the aerobic digester without draining the digester’s contents. It shall be mounted on a slide rail to avoid movement of the unit while in operation.
- D. The mixers shall be suitable for mixing of waste activated sludge from an oxidation ditch/secondary clarifier municipal wastewater treatment plant. The mixers shall be suitable for heavy-duty continuous service. The specific gravity of the waste activated sludge shall be equal to 1.03.
- E. The equipment manufacturer shall be experienced in manufacturing pumping equipment of this technology as specified and have a record of successful in-service performance. Manufacturer must have at least ten (10) years experience with (20) similar facilities in operation.

**1.03 Performance Requirements**

- A. Each mixer shall meet the following sizing and performance requirements:
  - 1. Sized and configured to achieve uniform mixing of waste activated sludge to promote sludge mixing under the specified operating conditions.
  - 2. Assume sludge specific gravity at 1.03 and digester cell dimensions as shown on the contract drawings.
  - 3. Motors shall be 1.5 HP, 480 volts, 3 phase, and 60 hertz and shall be fitted with a 120 VAC space heater.

**1.04 Design Submittals**

- A. The Contractor shall provide the following submittals, in accordance with Section 01300 - Submittal Procedures and submittal 15020 – Basic Mechanical Requirements.
  - 1. Shop drawings, material list, and catalog information showing pertinent details, materials of construction, dimensions, loads and mounting details of mixer.
  - 2. Power consumption curves verifying the required performance characteristics specified herein.
  - 3. Outline installation drawings for each unit.
  - 4. Critical data on the design and operating conditions of the equipment.

5. Electrical characteristics.
  6. Bill of materials.
  7. Calculations, if requested, for the following but not limited to: AGMA service factor, energy dispersion, energy calculations, mounting requirements, bearing life, critical speed, etc.
  8. List(s) of recommended Spare Parts and Special Tools.
  9. Seismic anchorage requirements per Section 01612 – Seismic Design Criteria.
- B. Manufacturer's Instructions and Field Reports: In accordance with the requirements of Section 11010 - General Requirements for Equipment instructions for installation and testing of equipment shall be provided with equipment submittals. A manufacturer's certification letter shall be submitted in accordance with Section 01660 - Testing and Startup.
- C. Operation and Maintenance: In accordance with Section 11010 - General Requirements for Equipment paper or electronic copies of the primary equipment Operation and Maintenance manuals shall be submitted for information with the initial equipment submittals. This is in addition to the information that shall be submitted in accordance with Section 01360 - Operating and Maintenance Information.

## **PART 2 - PRODUCTS**

### **2.01 Acceptable Manufacturers and Models**

- A. Mixtec Model No. 1057.
- B. Or approved equal.

### **2.02 Equipment Fabrication / Construction**

- A. Each mixer assembly shall consist of an impeller, shaft, coupling, mounting base, reducer, C-face adapter, and a motor as detailed below.
- B. Impeller:
  1. The impeller shall be a high efficiency, axial flow hydrofoil type specifically designed to minimize shear / turbulence while maximizing fluid motion. This impeller is specifically designed to not induce a vortex or collect materials that can foul the mixer and excess overhung loads on the mixer shaft.
  2. Single impeller system.
  3. Achieve a minimum of 3 TTO/min
  4. Achieve a minimum in tank velocity of 30 ft/min.
  5. The power number should not exceed 0.47
  6. The impeller shall have a Diameter versus Tank (D/T) ratio of not less than 0.3 -0.4 D/T and for down pumping impellers be 0.33 -1.0 D off tank bottom.
  7. The tip speed should not exceed 13 ft/sec OR be less than required to sufficiently suspend solids from the digester floor into process.
  8. The impeller blades should be bolted to the hub which in turn should be welded to the shaft.
  9. The complete impeller system should be made from 316 SST.
- C. Impeller Shaft:
  1. The shaft shall be made from solid 316 SST bar

2. The shaft diameter shall be not less than 1.75"
3. The combined torsional and bending stresses shall not exceed the following:
  - a. Solid shafts – Stainless Steel, 6500 psi in shear & 11500 psi in tension,
  - b. Critical speed shall not exceed 70% of the first critical speed
  - c. Run out shall not exceed 0.2% of the shaft length
  - d. Shaft length shall not exceed 12 feet per section
  - e. Connection to reducer shaft shall be through rigid flanged coupling as detailed below

#### D. Coupling

1. The rigid flanged coupling shall be in two parts, female section to shaft and male section to reducer.
2. Each coupling shaft shall be, heat shrunk on to shaft member, keyed and fastened with grub screw, welded, or pinned, depending on its size.
3. Material shall be Carbon Steel for above decking grade.

#### E. Mounting Arrangement

1. The mounting arrangement will be a flat baseplate design.

#### F. Gear Reducer

1. Speed reducer shall be specifically designed for mixing duty and shall be suitable for 24hr/day continuous operation. The speed reducer shall be of a modular design with a housing material of gray cast iron, (GG20 equivalent to SAE Class 30).
2. All of the main components will be contained in a one-piece housing. All bearing bores, pilots, and registers of the housing will be machined in one set-up.
3. Reducer will be painted with stainless steel paint, water reducible, acrylic emulsion pigmented with alloy 316 stainless steel flakes. It will be non-flammable, low VOC, and deliver high corrosion resistance, long term durability and good abrasion resistance.
4. General Maintenance, specifically including replacement of all anti-friction bearings, oil seals and bearings and lubricant maintenance will require removal of the speed reducer housing from its foundations.
5. The gear reducer shall be a right angle or parallel helical design with a combination of helical and spiral bevel gearing. Worm gears and planetary gearing is not acceptable.
6. Oil Leakage down the low-speed upper shaft shall be prevented by means of an "Effective Drywell". Reducer will employ an Effective Drywell design to prevent contamination of mixing medium from lubricant leakage. Output shaft shall have two intermediate shaft seals to hold lubricant in the gear case. In case of lubricant leakage through the lower shaft seals the lubricant will run over an oil slinger placing the leakage into a safety chamber in the flange below the gear case. Lubricant will collect at the lowest point at which an oil indicator or oil sensor is placed. Alternatively, the lubricant can exit the safety chamber through a relief pipe in place of the indicator. On the output shaft below the oil slinger will be a grease packed spherical roller bearing followed by another seal to assure there will be no leakage.
7. Lubrication for the reducer will be mineral based gear oil, which will have an equivalent viscosity of ISO VG 220 or AGMA EP5. The oil will operate with an ambient temperature range of 20 to 104 F (-5 to 40 C). Food grade or high temperature synthetics are also available.
8. The gear reducers are provided with long term storage inhibitors to prevent corrosion during storage periods that are extended beyond expectations.

9. Gear drive lubrication shall be achieved by immersion of gears and bearings in an oil bath or splash lubrication. The lubrication shall not require priming, heaters, or other special effort or equipment for start-up in extremely cold or highly variable climates.
10. Reducer will have a check-valve with a spring pressing a ball against a machined orifice to allow the reducer to dissipate internal pressure while preventing lubricant contamination during cooling or a filtered vent that allows the gear reducer to vent while utilizing a filter to prevent foreign particulate material from entering the gearbox.
11. A single oil drain shall be provided at the lowest point of the reducer to allow oil drainage and a minimum residual of oil no more than ¼" in the drive housing.
12. The AGMA service factor shall be not less than 2.0 based on full motor nameplate horsepower. The thermal rating of the speed reducer shall exceed the design mechanical rating to eliminate the need for external cooling devices. External cooling devices are not permitted. All gearing shall be helical AGMA 11 minimum and gears material will be a minimum SAE 8620 casehardened steel, hardened to 58-62 Rockwell-C. Gears will be immersed completely in lubricant. Worm gears are not acceptable.
13. All reducer bearings shall have a minimum B-10 bearing rating of 100,000 hours based on full motor nameplate horsepower. All bearings shall be immersed in lubricating oil or if they above the oil level they will be sealed with nylon rings and grease packed to ensure positive lubrication.
14. The reducer will be capable of operating at the full range of shaft speeds specified where a VFD is installed.
15. The reducer shall be provided with a sight glass to observe oil levels.
16. The output shaft shall be equal to or oversized from the mixer shaft. Output shafts shall be furnished with high quality dual lip seals or better.
17. Drives and mixer shaft are designed, fabricated and factory tested by the mixer manufacturer.

#### G. Drive Motor

1. The mixer shall be powered by a TEFC premium efficiency inverter duty motor and be integral with the reducer or be connected to the reducer with a suitable C-face adapter using a one-piece coupling. This coupling shall be a nylon curved tooth gear coupling with a bronze insert. The bronze insert will prevent steel to steel contact allowing ease of motor disassembly even after years of service. IEEE 841, severe duty and explosion proof motors are available, as needed/required, under the same standards.
2. The inverter duty motor shall be an AC squirrel cage induction motor, 230/460 VAC, 60-hertz, 3-phase, with a nominal synchronous speed of 1800 rpm suitable for VFD operation.
3. Motor will have Class F insulation and Class B temperature rise.
4. Service Factor minimum of 1.15
5. The mixer shall be designed to operate at 85% of the motor nameplate rating.
6. B10 bearing life not less than 50,000 hrs

#### H. Coatings

1. In accordance with Section 09900.
2. When required, rubber lined parts shall be lined to a thickness (nominally ¼") the manufacturer feels will minimize wear, based on experience general industry standards.

#### I. Spare Parts

1. Submit a list of recommended spare parts.

## J. Lubricants

1. Provide lubricants required for startup and initial operation.

### **2.03 Controls**

- A. Controls shall be provided in accordance with Division 16 requirements.

### **2.04 Quality Assurance**

#### A. Factory Testing

1. Each mixer shall be tested at the factory for correct operation, lubrication, operating temperature, proper assembly and unobstructed impeller rotation. Upon request, a test sheet certifying suitable operation shall be shipped with each aerator.

#### B. On-site Performance Testing

1. The manufacturer shall provide all equipment required to conduct velocity and mixing tests in the field.

### **2.05 Delivery, Storage, and Handling**

- A. All equipment shall be shipped and delivered fully assembled, except where partial disassembly is required in order to conform to transportation regulations or for the protection of components.
- B. The Contractor shall be responsible for unloading of the machinery and shall have equipment on-site available at the time of delivery permitting proper hoisting of the equipment.

### **2.06 Warranty**

- A. The manufacturer shall furnish a written warranty to cover the mixers against defects in workmanship and material for a period of one year and rotating parts for a period of one year under normal use and service from the date of acceptance of installation by the manufacturer's representative.
- B. The manufacturer's warranty shall be issued in the Owner's name.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Equipment shall be installed in strict conformance with the drawings and the manufacturer's installation instructions and recommendations.

### **3.02 Field Quality Control**

- A. Perform Field Testing, Start-up and Demonstration in Accordance with the requirements of Section 01660 and additional requirements stated herein.
- B. Field Inspection
  1. After the installation of the units and all appurtenances, each unit shall be subjected to a field running test under actual operating conditions. The field tests shall be made by the Contractor in the presence of and as directed by the Construction Manager. The field tests shall demonstrate that under all conditions of operation each unit:
    - a. Has not been damaged by transportation or installation.
    - b. Has been properly installed.
    - c. Has no mechanical defects.

- d. Is in proper alignment.
- e. Has been properly connected.
- f. Is free of overheating of any parts.
- g. Is free of all objectionable vibration.
- h. Is free of excessive noise.
- i. Is free of overloading of any parts.
- j. Shall operate as specified with the control system.
- k. Meets the performance requirements indicated.
- l. Any defects in the equipment or failure to meet the requirements of the Specifications shall be promptly corrected by the Contractor.

### C. Field Testing

1. Operate for at least 2 hours after components reach normal operating temperatures. Operate at rated design load conditions.
2. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
3. Manufacturer shall inspect system before initial start-up and certify that system has been correctly installed and prepared for start-up.
4. Repeat tests if necessary to obtain results acceptable to engineer.

### **3.03 Manufacturer's Representative**

- A. A qualified manufacturer's representative shall inspect the installation of the equipment, make any necessary adjustments, test and place the equipment in satisfactory operating condition. The manufacturer's representative shall also instruct the plant operating personnel in the operation and maintenance of the equipment.
- B. Manufacturer's qualified representative shall provide the requisite services (Inspection, Startup, and Training) for a minimum of eight (8) hours, travel time excluded:
- C. Training details to be submitted three (3) weeks prior to scheduled training. The training session time and date shall be scheduled with the Owner through the Construction Manager.

**\*\*END OF SECTION\*\***

**SECTION 11300  
RECIPROCATING POSITIVE DISPLACEMENT PUMPS**

**PART 1 - GENERAL**

**1.01 Summary**

A. Work included: Furnish and install double disc sludge pump as specified in this section and where shown on the drawings. Pumps shall be complete pump unit consisting of pump, v-belt drive arrangement, and motor all completely assembled on fabricated stainless steel base and shall conform to the pump requirement described herein.

**1.02 Related Sections**

A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/AGMA 6010-E-88	Spur, Helical, Herringbone, and Bevel Enclosed Drive
ANSI/AGMA 6019-E-89	Gear Motor Using Spur, Helical, Herringbone, Straight Bevel, or Spiral Bevel Gears
AGMA 6023-A88	Design Manual for Enclosed Epicyclic Gear Drives

**1.03 Definitions**

- A. RAS – Return Activated Sludge
- B. WAS – Waste Activated Sludge

**1.04 System Description**

A. Equipment Tag Numbers:

<u>Tag Number</u>	<u>Service</u>	<u>Drawing Reference</u>
P-330	RAS/WAS Pump	I003
P-340	RAS/WAS Pump	I003

B. General

- 1. The pumps shall be designed for waste sludge handling.

**1.05 Experience and Quality Assurance**

- A. The equipment manufacturer shall be experienced in manufacturing pumping equipment of this technology as specified and have a record of successful in-service performance. Manufacturer must have at least ten (10) years experience with (20) similar facilities in operation.
- B. The equipment shall be 100% manufactured in the U.S. and all spare parts shall be available for same day shipment and next day delivery. The manufacturer shall maintain a fully equipped shop facility to perform all operations including welding, fabrication, assembly and testing. All materials shall be designed to withstand the stresses encountered in fabrication, erection and operation. All equipment

shall be of corrosion resistant materials or shall be suitably protected by the supplier with corrosion resistant industrial coatings approved by the engineer.

**1.06 Submittals**

A. Shop Drawings: Complete assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, drive unit, parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the submittals section. The data and specifications for each shall include detailed information on the pump to include:

1. Pump
  - a. Manufacturer
  - b. Type and model
  - c. RPM at rated condition
  - d. Size of suction and discharge flanges
  - e. Complete performance curves
  - f. Net weight of pump and baseplate
  - g. Base and anchor bolt details
  - h. Data on pressure sensor and switch assemblies
2. Motor
  - a. Manufacturer
  - b. Type, model, and enclosure
  - c. Rated size of motor, hp an service factor
  - d. Temperature rise and insulation rating
  - e. Full load rotative speed
  - f. Net weight
  - g. Efficiency at full,  $\frac{3}{4}$ , and  $\frac{1}{2}$  load
  - h. Full load current
  - i. Locked rotor current
  - j. Overall dimensions and base details
  - k. Power factor at no load and at full load
3. Seismic anchorage requirements per Section 01611 – Seismic Design Criteria.

B. Operation and Maintenance Manuals: Complete with manufacturer’s instructions for equipment installation, equipment function, start-up procedures, operation, preventative maintenance, servicing and troubleshooting.

**1.07 Performance Requirements**

A. Each pump shall meet the following performance requirements:

Material Being Pumped	Return/Waste Activated Sludge
Maximum Percent Solids	3

Number of Pumps	2
Maximum Capacity - Each Pump (GPM)	225
Maximum Total Dynamic Head in Feet	36
Minimum Capacity - Each Pump (GPM)	15
Phase 1 (Duty Point) – Each Pump (GPM)	113
Phase 1 Total Dynamic Head in Feet	27
Suction & Discharge Port Size	6", 150 lbs., flanged
Drive Type	V-belt and pulley arrangement
Maximum Pump Speed (RPM)	235
Minimum Motor Horsepower	10
Maximum Motor Speed (RPM)	1200
Service Factor	1.15 minimum
Motor Enclosure	TEFC
Motor Electrical	230-460/3 Ph/60 Htz
Motor Space Heater	120 VAC

- B. The pumps shall be capable of pumping a minimum of 1 gallon per revolution when operating at 60ft head.
- C. The pumps shall be capable of operating dry for an indefinite period of time without damage. The pumps shall be capable of self-priming up to 14" Hg and 25" Hg when fully primed.

**1.08 Warranty**

- A. The equipment shall be warranted for a minimum period of one (1) year against defects in workmanship and materials under normal use, operation and service. If the equipment should fail during the warranty period due to a defective part, it shall be replaced, and the units restored at no expense to the owner.

**PART 2 - PRODUCTS**

**2.01 Acceptable Manufacturers**

- A. Penn Valley Pump Company, Inc.
- B. Or Approved Equal

**2.02 Components**

- A. Each pump shall be a simplex heavy duty, free diaphragm, disc style positive displacement type, with Class 30 Cast Iron Housings. Duplex pumping arrangements shall not be acceptable. The pump shall consist of three (3) housings horizontally split to allow access to the internal components.
- B. The pump shall incorporate a Maintain-in-Place hinged design that allows the pump to be serviced and discs replaced without removal of the pump or disturbing the suction and discharge piping. The discharge housing shall contain the mounting lugs and be bolted directly to the mounting frame. The discharge, intermediate and suction housings shall incorporate an integral hinge arrangement that

allows the suction and intermediate housings to be lowered and removed. The hinges shall be connected to each other with a quick release ball detent pin allowing for easy pin removal.

- C. The pumping action shall be achieved by two (2) free floating reciprocating discs attached to high tensile aluminum connecting rods driven by a rotating eccentric shaft. Each disc shall be mounted to the connecting rod by a stub shaft constructed of hardened high tensile 400 series stainless steel. The discs shall be of integral design and constructed of high tensile neoprene with multiple layers of fabric for longevity and strength. Pump designs that use a captive diaphragm with metal plate shall not be acceptable. The suction and discharge discs shall be universal and interchangeable with each other.
- D. The reciprocating action of the discs shall also perform the duty of valves. Pumps that require internal check valves for operation shall not be acceptable.
- E. Sealing of the pump fluid chamber shall be achieved by flexible trunnions. The trunnion seal shall not be designed to provide any pumping action. The trunnion construction shall be of fabric-reinforced neoprene and shall be capable of withstanding pressures from 0 to 110 PSI on an intermittent basis. Maximum operating pressure is 140' TDH. Pump designs utilizing packing glands, mechanical seals or water seal systems are not acceptable.
- F. The swan neck entry port to the suction housing shall be a two (2) piece design allowing for mounting of the suction connection in 90 degree increments and easy access for clack replacement. The upper swan neck shall be provided with a 3" NPT connection to allow mounting of the suction pulsation dampener if required. The opening shall be a full 6" diameter with a minimum opening of 28.26 square inches to minimize debris buildup and blockages. The seating surface for the clack valve shall be machined on the mounting face of the swan neck. The clack valve shall be integrally mounted to the swan neck to facilitate access and replacement. The clack valve shall be manufactured of neoprene construction with multiple layers of fabric encapsulating a rigid core. The clack valve shall incorporate an integral O-ring seal for positive sealing. Designs that incorporate a separate clack valve plate and smaller diameter opening shall not be acceptable.
- G. The bearing drive assembly shall consist of two (2) aluminum modular pedestals designed to provide accurate bearing alignment, superior bearing loading and ease of assembly. The drive shaft shall be a minimum 1-15/16" diameter and capable of withstanding a dead head situation. The shaft shall be constructed of hardened 400 series high-tensile stainless steel and shall be mounted on four (4) self-aligning, sealed bearings. The eccentric cams shall be constructed of high tensile, cast bronze alloy and shall be pinned to the shaft by spirol drive pins to allow for the absorption of reciprocating loads generated by the pumping action. Pump drive assemblies that utilize keyways and setscrews will not be acceptable. All drive bearings must be completely sealed with no provisions for scheduled grease lubrication. No grease fittings shall be supplied for the bearings.
- H. The pump shall be driven through a V-belt and drive assembly consisting of a 2 or 3 groove Type B arrangement. The pulley ratios shall be sized to provide the maximum pump speed listed in the pump schedule in this section and to provide the required torque generated between the pump and motor.
- I. Pump shall be provided with OSHA approved guards and covers. The V-belt drive cover and pump drive assembly cover shall be manufactured from SS304 material.
- J. Each pump and V-Belt assembly shall be mounted on a common SS304 sub base. Base design shall have raised cross-members on the suction and discharge end to allow for complete wash-out and draining without trapping liquid. Each sub base shall be manufactured from 2-1/2" SS304 square tubing. Base shall be sufficient gusseted, reinforced and braced to withstand all shock loads and resist all wearing and buckling during pump operation. Tubing ends shall be capped with black plastic plugs for neat appearance.
- K. Pulsation dampeners shall be provided on the suction and discharge lines. The dampeners shall be 6" ASA 150 lb flanged units and the main tube shall be 8" diameter SCH 40 carbon steel pipe with fully welded end caps. The suction dampener shall mount directly to the suction swan neck through the 3" NPT connection. The discharge dampener shall be a separate piece with 6" ASA 150# flanged

connections. The dampeners shall be pressure tested to 60 psi for leaks. Each dampener shall be provided with a 1-inch half coupling located at the top. This connection shall be suitable for the vacuum and pressure switch assembly or the ball valve/quick disconnect assembly should a switch not be specified. Each dampener shall be supplied with a 1 ½" NPT coupling and plug in the bottom to act as a drain/sample port. Bladder type and three-piece assemblies using connecting rods and gasket shall not be acceptable.

### **2.03 Motor**

- A. The motor shall be adequately sized to withstand the loads during starting and pump operation. The power the horsepower and motor speeds shall conform to the specifications as outlined in the pump schedule in this section. Motor shall be severe duty, premium efficient, inverter ready per NEMA STD MG1 Part 31.4.4.2 with epoxy coated cast iron frame or equal.
- B. The motor shall have AEGIS shaft grounding ring for protection.

### **2.04 Variable Frequency Drive**

- A. Must be heavy duty for constant torque applications suitable for the severe duty motor provided by the pump manufacturer.

### **2.05 Suction Vacuum Protection**

- A. The pump manufacturer shall provide a suction vacuum sensor and switch assembly to mount on the suction pulsation dampener. The sensor shall be a PVP420, Red Valve 42/742 or equal 1-inch NPT isolation pressure sensor with SS316 body and EPDM elastomeric sensing tube. The process pressure is sensed through the 360- degree elastomeric tube and glycerin transfers pressure to the gauge and switch. The gauge and switch shall be attached to the sensor with SS316 fittings. The vacuum assembly shall be fitted with 4" stainless steel 30"Hg – 30psi gauge and Ashcroft, Barksdale, or equal adjustable vacuum switch set at 10"Hg. The units shall be capable of being cleaned in place by simply using the process pressure through a SS316 isolation valve mounted to the top of the sensor. The opposite end of the valve shall be fitted with a universal, quick acting coupling, suitable for compressed air. This valve connection will be suitable to charge the dampener with compressed air.

### **2.06 Discharge Pressure Protection**

- A. The pump manufacturer shall provide a discharge pressure sensor and switch assembly to mount on the discharge pulsation dampener. The sensor shall be a PVP420, Red Valve 42/742 or equal 1-inch NPT isolation pressure sensor with SS316 body and EPDM elastomeric sensing tube. The process pressure is sensed through the 360- degree elastomeric tube and glycerin transfers pressure to the gauge and switch. The gauge and switch shall be attached to the sensor with SS316 fittings. The discharge assembly shall be fitted with a 4" stainless steel 0 -100 psi pressure gauge and shall be fitted with Ashcroft, Barksdale, or equal, adjustable switch preset at 30 psi. The units shall be capable of being cleaned in place by simply using the process pressure through a SS316 isolation valve mounted to the top of the sensor. The opposite end of the valve shall be fitted with a universal, quick acting coupling, suitable for compressed air. This valve connection will be suitable to charge the dampener with compressed air.

### **2.07 Special Tools and Spare Parts**

- A. Provide the following factory recommended spare parts, one (1) set total consisting of:
  - 1. Two (2) Discs
  - 2. Two (2) Trunnions
  - 3. One (1) Complete set of gaskets

4. One (1) Clack valve
  5. One (1) Disc Tool
- B. The pump manufacturer shall supply a universal, adjustable tool to aid in disc removal.

## **2.08 Finishes**

- A. All cast iron and carbon steel components shall be finished with manufacturers standard industrial grade primer 2 – 3 mils DFT suitable for multiple top coat finishes. The top coat shall be industrial enamel 2 – 3 mils DFT.
- B. All stainless steel and aluminum surfaces will remain unpainted. All weld splatter shall be removed and all welds ground smooth for a neat appearance.

## **PART 3 - EXECUTION**

### **3.01 Field Representative Services**

- A. The equipment manufacturer shall furnish a qualified field service representative for the purpose to inspect the equipment after installation and to supervise its initial operation. The manufacturer's representative shall inspect the installation and shall provide a written certification that the pump is installed in accordance with the manufacturer's requirements. In addition to the time required to verify pump installation the following shall be provided:
1. Two (2) man-day(s) for start-up and training services

### **3.02 Installation**

- A. Install all items in accordance with the printed instructions of the manufacturer, as indicated and specified.
- B. Dowel to frame after alignment in the field to facilitate realignment after disassembly.
- C. Install and align on a concrete pad as specified in the drawings.
- D. Brace all piping at suction and discharge connections to withstand all shock loads and vibration.

### **3.03 Acceptance Tests**

- A. Furnish labor, piping, equipment and material for conducting the tests.
- B. Give each pump a running test in the presence of Engineer demonstrating its ability to operate without vibration or overheating and deliver its rated capacity under specified conditions. The following items shall be measured at five (5) points over the entire operating range:
1. Discharge Head
  2. Suction Head
  3. Capacity
  4. Pump Speed
  5. Amperage draw
- C. Correct all defects or replace defective equipment, revealed and noted during tests. Make necessary adjustments at the time of tests at the expense of contractor.
- D. Repeat tests if necessary to obtain results acceptable to engineer.

**\*\*END OF SECTION\*\***

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## **SECTION 11352 CIRCULAR CLARIFIER EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 Summary**

- A. This Section specifies sludge collector equipment for the installation in a circular secondary clarifier of center feed, peripheral overflow design.

#### **1.02 References:**

- A. American Bearing Manufacturers Association (ABMA):

1. 9 - Load Ratings and Fatigue Life for Ball Bearings.

- B. American Gear Manufacturers Association (AGMA):

1. 908 - Information Sheet - Geometry Factors for Determining the Pitting Resistance and Bending Strength of Spur, Helical, and Herringbone Gear Teeth.
2. 915-1 - Inspection Practices - Part 1: Cylindrical Gears - Tangential Measurements.
3. 915-2 - Inspection Practices - Part 2: Cylindrical Gears - Radial Measurements.
4. 2001 - Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
5. 2004 - Gear Materials, Heat Treatment and Processing Manual.
6. 2009 - Bevel Gear Classification, Tolerances and Measuring Methods.
7. 2011 - Cylindrical Worm Gearing Tolerance and Inspection Methods.
8. 2015-1 - Accuracy Classification System - Tangential Measurements for Cylindrical Gears.
9. 2015-2 - Accuracy Classification System - Radial Measurements for Cylindrical Gears.
10. 6013 - Standard for Industrial Enclosed Gear Drives.
11. 6022 - Design Manual for Cylindrical Wormgearing.
12. 6034 - Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
13. 9005 - Industrial Gear Lubrication.

- C. American Institute of Steel Construction (AISC):

1. 360 - Specification for Structural Steel Buildings.

- D. American Society of Mechanical Engineers (ASME):

1. B29.1M - Precision Power Transmission Roller Chains, Attachments, and Sprockets.

- E. American Welding Society (AWS):

1. D1.1 - Structural Welding Code for Steel.
2. D1.6 - Structural Welding Code - Stainless Steel.

- F. ASTM International (ASTM):

1. A 36 - Standard Specifications for Carbon Structural Steel.
2. A 48 - Standard Specification for Gray Iron Castings.
3. A 148 - Standard Specification for Steel Castings, High Strength, for Structural Purposes.

4. A 276 - Standard Specification for Stainless Steel Bars and Shapes.
  5. A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  6. A 536 - Standard Specification for Ductile Iron Castings.
- G. International Organization for Standardization (ISO):
1. 53 - Cylindrical Gears for General and Heavy Engineering - Standard Basic Rack Tooth Profile.
- H. National Electrical Manufacturers Association (NEMA):
1. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

### **1.03 Definitions**

A. NEMA:

1. Type 4X enclosure in accordance with NEMA 250.
2. Type 7 enclosure in accordance with NEMA 250.

B. Continuous operation: 24 hour-per-day operation for design life of not less than 20 years which equals 175,200 hours.

C. Intermittent operation: Periodic operation, including starts and stops, and prolonged periods of resting.

D. Subassemblies: Includes, but may not be limited to, complete center column, drive cage, drive assembly, truss arms, and scum skimming system.

E. Set: Equipment necessary to completely furnish 1 clarifier.

F. Continuous running torque:

1. The 100 percent AGMA torque, assumed to be continuously applied, 24 hours a day, to the drive system.
2. Bearing life, gear strength, gear durability, gear rating, mechanism structural design, and alarm and shutdown setpoints are specified as a percentage of the continuous running torque.

G. Momentary peak torque:

1. The maximum torque for rating yield strength or ultimate strength of center drive mechanism components.
2. The numerical value for momentary peak torque shall be 2.0 times continuous running torque.

H. Manufacturer:

1. Firm responsible for the design, operation, delivery, installation certification, and warranty of sludge collection equipment.
2. The warranty shall be for a minimum period of five (5) years from start-up to 66 months from time of equipment shipment, whichever comes first. Such warranty shall cover all defects or failures of materials or workmanship which occur as a result of normal operation and service except for normal wear parts (i.e. squeegees, skimmer wipers, etc.).
3. Manufacturer shall also provide sludge collector drive mechanism.

I. Fabricator:

1. Firm responsible for the fabrication of sludge collection equipment conforming to the manufacturer's design.
2. Manufacturer may also be the fabricator if fabrication of all components is self-performed.

## 1.04 System Description

### A. Nominal clarifier dimensions:

1. Diameter: As indicated on the Drawings.
2. Side water depth: As indicated on the Drawings.
3. Bottom slope: As indicated on the Drawings.
4. Bottom cone: As indicated on the Drawings.

### B. Sludge collector mechanism:

1. Supply as a complete and operational system by a single manufacturer.
2. Equipment to include, but not be limited to, the following components:
  - a. Walkways and access bridges with guardrail and grating with coordination with access stair structural design to facilitate joining of stairs to walkway
  - b. Center column.
  - c. Influent feedwell.
  - d. Center drive shaft.
  - e. Sludge collector truss arms with cone scrapers.
  - f. Scum skimming system.
  - g. Unit drive mechanism and torque control.
  - h. Drive motor.
  - i. Electrical controls.
  - j. Overload devices and alarms.
  - k. Alarms.
  - l. Other components necessary to provide a complete system.

### 3. Design Criteria:

Parameter	Units	Value
Tag Number	-	M-320
ADF (Average Daily Flow)	gpd	108,000
MMF (Maximum Monthly Flow)	gpd	216,000
MDF (Maximum Day Flow)	gpd	324,000
PHF (Peak Hour Flow)	gpd	432,000
BOD <sub>5</sub>	mg/L	225
Suspended Solids	mg/L	225
Nitrogen, N	mg/L	40
pH	-	6.0-7.4
Low Temperature	°C	10

Max MLSS	mg/L	4,000
RAS SS	mg/L	10,000
Min DT @ 10°C	hrs	2.7
SOR @ Peak Typical	gal/d/ft <sup>2</sup>	400-800
Max WOR	gal/d/ft <sup>2</sup>	10,000
SLR Typical	lbs/d/ft <sup>2</sup>	25-30

- a. Maximum allowable headloss through the center column and influent well at peak flow = 2 inches.

4. Process description:

- a. The sludge collector mechanism includes a central driving mechanism mounted on a center support pier which supports and rotates a center cage with 2 truss arms and 1 surface skimmer.
- b. Sludge accumulated in the clarifier is scraped to a center well for continuous removal.
- c. Scum from the surface of the clarifier is collected and deposited into a scum collection hopper using skimming arms with articulated blades.

C. Mechanical design:

1. Use no chains, sprockets, bearings, or gears below the water surface.
2. Design for a continuous running torque of 3,200 ft-lbs. running and 6,400 lbs. momentary peaks.
3. Drive overturning moment: 100,000 ft-lbs.
4. Design collector mechanism to operate at a tip speed, measured at the ends of the truss arms, of approximately 9 feet per minute.

D. Structural design:

1. Design the sludge collector mechanism in accordance with AISC 360 except:
  - a. Provide a 3/16-inch minimum thickness for all members, except where specifically modified for specified equipment components.
  - b. Include stresses in members caused by bending and twisting due to eccentricities in members.
2. Slenderness ratio (KL/R) using K value of 1.0 shall not exceed the values specified below:
  - a. Tension members not greater than 240.
  - b. Compression members not greater than 200.
3. Corrosion allowance:
  - a. For all carbon steel A36 structural members, add 1/8 inch to the thickness used for the final design calculations to check member stresses and buckling.
  - b. This corrosion allowance is to be applied to the design thickness and not to the minimum member thickness specified earlier.
  - c. The final member thickness shall be the greater of the specified minimum thickness or the sum of the design thickness and the corrosion allowance.
4. Base member weights used for design on final full member thickness.

5. Full member thickness may be used for performing deflection calculations.
6. Design the center cage and the truss arms as an integral structure. Design the center cage and the connections to the truss arms for the reactions from the truss arms.
7. Do not include live load where its inclusion results in lower stresses in a member under investigation.
8. Seismic loads: Seismic loads in accordance with the building code as specified in Section 01410 where load and resistance factor design (strength design) is used.
  - a. Hydrodynamic loads:
    - 1) Influent well: Total load of 15 kilopounds applied appropriately to the inside and outside surfaces.
    - 2) Center column: Total load of 3 kilopounds applied appropriately to the outside surfaces.
    - 3) All other elements: Hydrodynamic loads as determined using the seismic criteria specified in Section 01611.
  - b. Hydrodynamic loads for allowable stress design (alternate design method) shall be equal to the load and resistance factor design loads divided by 1.4.
  - c. Seismic loads due to weight of mechanism; as determined using the seismic criteria specified in Section 01611. Include the water inside the center column as part of the weight of the center column.
9. Load combinations: Design each structural member of the sludge collector mechanism shall for the most critical load combination resulting from the following load combinations:
  - a. Dead load plus live load plus continuous running torque.
  - b. Dead load plus live load plus continuous running torque plus seismic load:
    - 1) Seismic load shall include seismic load from the water inside the clarifier acting on members of the clarifier mechanism.
    - 2) For elements of the clarifier such as the center column and the influent well, impulsive and convective seismic loads from the water shall be applied appropriately on both the inside and outside surfaces.
    - 3) These seismic loads shall be in addition to the seismic loads due to the dead loads of the elements.
  - c. Dead load plus live load plus torque due to screening grout topping on slab using sludge collector mechanism.
  - d. Dead load plus live load plus torque due to cutout torque test.
  - e. Other load combinations selected by the manufacturer.
  - f. Truss arm load cases: Use the following load cases on the truss arms for load combinations:
    - 1) Equal uniform horizontal load along the full length of both truss arms which results in a combined torque equal to the continuous running torque.
    - 2) Uniform horizontal loads along the full length of both truss arms which results in 70 percent of the torque from 1 truss arm and 30 percent of the torque from the other truss arm for a combined torque equal to the continuous running torque.
    - 3) Load on truss arms due to spreading grout topping on slab using sludge collector mechanism.
    - 4) Load on truss arms due to cutout torque load test.

10. Deflections:

- a. The horizontal deflection of the truss arm, due to truss deflection plus rotational deflection of the center cage for load cases which contain continuous running torque, shall not exceed a deflection equal to the radius of the clarifier divided by 400 (L/400):
  - 1) Not more than 60 percent of the total horizontal deflection shall be due to center cage rotation measured at the cage.
  - 2) Horizontal deflection of the truss arm shall be measured at the end of the sludge collection header furthest from the center column.
- b. The vertical deflection of the truss arm due to equipment dead load shall not exceed the length of the truss arm divided by 800 (L/800).

11. Seismic design criteria: As specified in Section 01611.

**1.05 Submittals**

A. Submit product data and shop drawings, operation and maintenance manuals, and test reports.

B. Product data and shop drawings:

- 1. Shop drawings shall consist of a cover sheet indicating the drawing number and specification page and number to which referenced, intended use and data summary, outline drawings, cut-away drawings, parts lists, material specification lists, and all information required to substantiate that the proposed equipment meets the specifications:
  - a. Shop drawings submittals will not be considered complete if cut-away or assembly drawings with part and material specification lists are not included.
- 2. General arrangement drawings showing the complete assembly, part numbers, and materials list.
- 3. Detailed drawings:
  - a. Sludge collector mechanism indicating dimensions, member sizes and thicknesses, welding, and connection details.
  - b. Drive mechanism showing sizes, dimensions, and arrangement of each drive component.
  - c. For gears, except those contained in the gearmotor speed reducer, detailed drawings with the following minimum data for each gear:
    - 1) Number of teeth.
    - 2) Net face width.
    - 3) Outside diameter of external gears.
    - 4) Inside diameter of internal gears.
    - 5) Normal diameter pitch or axial pitch for worms.
    - 6) Normal generating pressure angle.
    - 7) Lead angle (for worms).
    - 8) Operating center distance.
    - 9) Addendum modification coefficient.
    - 10) Tooth thickness or pin or span measurements.
    - 11) Quality numbers in accordance with AGMA 915-1, 915-2, 2009, 2011, 2015-1, and 2015-2.

- 12) Material alloy.
- 13) Type of heat treatment.
- 14) Tooth surface hardness.
- 15) Tooth core hardness.
- 16) For case hardened gears, effective case depth to Rc 50.
- 17) Lubricant type (mineral/synthetic/EP).
- 18) Lubricant viscosity.

- d. Certified motor data sheets.
- e. Shop primer and coating data.
- f. Control system data, schematics, and wiring diagrams.
- g. Spare parts lists.
- h. Qualifications and resume of installation engineer.
- i. Training course outlines.
- j. Manufacturer's experience and reference list as specified in Quality Assurance.

C. Manufacturer's Installation Instructions.

D. Calculations: Include, without necessarily being limited to:

1. Structural calculations:

- a. Calculations shall be prepared and signed by a professional civil engineer licensed in the state where the Project is located demonstrating compliance with structural criteria specified in this Section and seismic design criteria as specified in Section 01611. Include anchorage calculations.
- b. Submit design calculations with complete shop drawings.

2. Mechanical and hydraulic calculations: Performed by a professional civil or mechanical engineer licensed in the state where the Project is located. Calculations are intended to:

- a. Substantiate continuous running torque rating and overload torque loading of each component of drive mechanism:
  - 1) Calculations shall be in accordance with AGMA 908.
  - 2) Calculations shall clearly specify all design parameters used in developing the ratings, including materials in accordance with AGMA 2004.
  - 3) All ratings shall be in strict conformance with the latest revisions of AGMA 6034 and AGMA 2011.
- b. Demonstrate that each bearing in drive mechanism complies with life requirements of this Section.

3. Complete process calculations substantiating the sizing of the center columns and ports, energy dissipating inlet (EDI) column and outlets, and outer feedwell. These calculations shall be based on parameters from the manufacturers operating experience. These parameters shall be verified by data presented from successful operating installations.

E. Reference list: Include the following information as a minimum:

- 1. Name and location of installation.
- 2. Name and telephone number of the person in direct responsible charge of the equipment.

3. Name and contact information for equipment fabricator.
  4. Name and contact information for manufacturer's engineer responsible for structural design.
  5. Month and year the equipment was placed in operation.
  6. Size of equipment.
  7. Number of units installed.
  8. Service.
- F. Quality control submittals:
1. Welder's certificates.
  2. Submit manufacturer's or designated contract fabrication facility's structural steel fabrication qualifications and information.
  3. Engineer's qualifications to complete structural analysis and design.
- G. Fabrication certification report:
1. Provide fabrication certification report prior to equipment delivery to project site.
- H. Test reports:
1. Method of conducting cutout test and verification that method of testing will not impose stresses in any member which exceeds maximum allowable stresses specified in this Section.
  2. Results of field torque tests on sludge collector mechanism.
- I. Operation and Maintenance Manuals.
- J. Certificates: Manufacturer's certification that equipment was installed in accordance with the manufacturer's instructions, inspected by the manufacturer, serviced with the proper initial lubricants, and equipped with applicable safety equipment and controls.
- K. Technician's qualifications resume: Submit resume of technician to perform manufacturer's field service.

## **1.06 Quality Assurance**

- A. Manufacturer qualifications:
1. Experience: Demonstrate minimum 15 years experience in the manufacture and fabrication of cone scraper sludge collectors which have been successfully utilized in domestic wastewater applications:
    - a. Experience of fabricator, if manufacturer does not self-perform fabrication, shall meet or exceed that required of manufacturer.
    - b. Submit substantial information as necessary to establish qualifications of fabricator, if manufacturer does not self-perform fabrication, including location (address), experience, qualifications, and certifications of all fabricator's staff to be utilized.
    - c. Manufacturer's engineer responsible for structural design shall also demonstrate minimum 5 years experience designing sludge collectors to withstand operational and seismic loads, including sloshing of tank contents on sludge collection mechanism.
  2. References: Provide a reference list of at least 25 different installations in domestic wastewater treatment plants of not less than 5 million gallons per day in the continental United States, where the manufacturer has supplied equipment substantially similar in design and characteristics to that proposed in this Section:
    - a. The installations listed must:

- 1) Have been designed and fabricated by the manufacturer. If manufacturer does not self-perform fabrication, the installation list shall also include the experience of the Project equipment fabricator.
  - 2) Are at least 30 feet in diameter.
  - 3) Have been in operation for last 5 years.
- b. Provide the following information related to the installation:
- 1) Owner name, address, and telephone number.
  - 2) Design flow of plant.
  - 3) Sludge collector dimensions.
  - 4) Time in operation.
  - 5) References for manufacturer's engineer responsible for the structural design.

B. Welding and welder qualifications:

1. Perform welding and qualify and certify welders in accordance with AWS D1.1 and D1.6.
2. Welds:
  - a. Use shielded arc welding.
  - b. Conform to requirements of design loads.
  - c. Conform to information indicated on the Drawings.
  - d. Use continuous watertight seal welds for bridge construction.
  - e. Use a minimum weld size of 1/4-inch for bridge construction and 3/16-inch for all other construction.
  - f. Field welding permitted only for bridge splice (if required).
  - g. Engineer may check materials, equipment, and qualifications of welders.
  - h. Remove welders performing unsatisfactory Work, or require to requalify.
  - i. Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
  - j. Manufacturer shall bear costs of retests on defective welds.
  - k. Manufacturer shall also bear costs in connection with qualifying welders.

C. Steel fabrication:

1. Manufacturer's authorized representative shall inspect fabrication of equipment.
2. Manufacturer's authorized representative shall provide a fabrication certification report complete with certified erection drawings, a journal of the fabrication work process, photo documentation of the shop assembly of all components required to be field erected, and a certification that the fabricated equipment is complete and ready for installation by the Contractor.

D. Equipment subassemblies:

1. Each component subassembly requiring field erection shall be test assembled and documented at the Manufacturer's fabrication facility.
2. Digital photographic evidence of assembly shall be submitted as part of the fabrication certification report.
3. Mark parts with erection matchmarks for ease of field erection.

4. Lubricate moving parts before shipment.
5. When necessary to disassemble parts for shipping, coat uncoated exposed machine surfaces with suitable, easily removable, rust-preventive compound before shipping.

### **1.07 Project Conditions**

#### **A. Environmental project conditions:**

1. Installation in a wastewater treatment plant.
2. Moderate quantities of commercial and industrial waste.
3. Exposure to industrial solvents and petroleum products.
4. Operation 4,000 feet above mean sea level.
5. Ambient air temperature:
  - a. Maximum 85 degrees Fahrenheit.
  - b. Minimum 10 degrees Fahrenheit.
6. Wastewater temperature:
  - a. Maximum 75 degrees Fahrenheit.
  - b. Minimum 31 degrees Fahrenheit.

### **1.08 Delivery, Storage, and Handling**

#### **A. Preparation for shipment:**

1. All materials shall be suitably packaged and braced to protect against damage during transit, handling, and unloading.
2. Manufacturer shall package equipment, be responsible for, and make good, any and all damage until the equipment is delivered to the job site.
3. Accessories shall be packaged separately in containers clearly marked "ACCESSORIES ONLY".
4. A packing list, listing the contents of each container, shall be placed in a moisture proof envelope and securely fastened to the outside of the container.
5. Provide written storage procedures for all equipment.

#### **B. Delivery to job site:**

1. Manufacturer shall fabricate and deliver materials to the job site in conformance with the Contractor's construction schedule to minimize handling and on-site storage of equipment.

#### **C. Storage and protection:**

1. Protect the system components at the site and during installation prior to project completion.
2. As a minimum, provide cover, ventilation, and proper stacking to prevent warping of any equipment stored on-site.

### **1.09 Sequencing and Scheduling**

#### **A. Coordinate work with work sequence specified in Section 01014.**

## **1.10 Maintenance**

- A. Spare parts: Furnish the following spare parts suitably packaged and marked. Include a price list and name, address, and telephone number of local supplier:
1. 2 sets of scum skimmer blade wear strips.
  2. 1 set of brass squeegees for each clarifier furnished.
  3. 4 sets of shear pins.
  4. 1 set neoprene scum skimmer wipers.
  5. 1 set each of oil seals for the worm shaft and pinion shaft.
- B. Special tools: Provide the following special tools:
1. Tools required to assemble, disassemble, repair, and maintain equipment, and that have been specifically made for use on the equipment.
  2. Necessary eyebolts, hooks, and rods for handling equipment parts.
  3. List of tools with the maintenance and operation data describing the uses of the tools.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Sludge collector mechanism:
1. All equipment components of the sludge collector mechanism including the walkways and access bridges, center column, influent well, center drive cage, sludge collector truss arms, scum skimming system, segmented scraper blades, center drive mechanism, drive motor, electrical controls, and overload devices and alarms, shall be furnished by the same manufacturer.
  2. Some equipment may require modification from the manufacturer's standard.
  3. Exercise care to assure that the electrical, mechanical, structural, and miscellaneous systems comply with the requirements specified or in other referenced sections.
  4. One of the following or equal:
    - a. Westech
    - b. ClearStream Environmental
    - c. Rock Water Equipment

### **2.02 Materials**

- A. For all components, unless otherwise specified, use the materials of construction specified below.
- B. Structural steel:
1. ASTM A 36 for clarifier bridge construction.
  2. ASTM A 276, Type 316L stainless steel for all other components.
  3. Grind all edges of steel members for bridge construction to approximately 1/16-inch minimum radius using standard workmanship and a grinder.
- C. Stainless steel, ASTM A 276, Type 316L:
1. Components or structural shapes which are welded:

- a. Materials: Type 316L stainless steel.
- b. Manufacturer's shop welds, welding procedures, and welders:
  - 1) Qualified and certified in accordance with the requirements of AWS D1.6.
- D. Anchor bolts: Type 316L stainless steel.
- E. Weir plate: Fiberglass reinforced plastic as specified in Section 06611.
- F. Scum baffles: Fiberglass reinforced plastic as specified in Section 06611.
- G. Fasteners and washers: Type 316L stainless steel, except for bolts which will be removed during installation and any high strength bolts.
- H. High strength bolts: Use ASTM A 325 hot-dip galvanized high strength bolts in attaching truss arms to cage, and cage to center drive gear casting.
- I. Do not use cadmium plated parts and fasteners.
- J. Dissimilar metals: All aluminum components shall be isolated from steel components as specified in Section 05500 to prevent electrolysis.

### **2.03 Walkways and access bridges:**

- A. Materials:
  - 1. Welded steel beam construction.
- B. Design:
  - 1. 36-inch wide walkway.
  - 2. Composed of 2 main members laterally braced together.
  - 3. Minimum live load of 100 pounds per square foot.
  - 4. Maximum deflection not to exceed span length divided by 360 ( $L/360$ ) for dead plus live loads.
  - 5. Support light standards and fixtures as indicated on the Drawings.
  - 6. Supported using:
    - a. Center column at one end and the outer concrete clarifier wall at the other as indicated on the Drawings.
    - b. Make allowance at outer concrete wall for expansion and contraction of walkway due to temperature changes:
      - 1) Use self-lubricating bearings.
      - 2) Do not use non-lubricated metal-to-metal slide plates or direct metal-to-concrete bearing.
      - 3) Prevent lateral movement of bridge at outer wall.
        - a) Provide additional structural support as required to support scum spray and other piping on the bridge as indicated on the Drawings.
- C. Platform at the center turntable: Provide a minimum clearance of 2 feet 6 inches around all sides of drive mechanism and provide uninhibited access to all parts of the drive unit.
  - 1. Guardrail with kickplate:
    - a. On both sides of walkway and all around center turntable platform.
    - b. Guardrail and kickplate as specified in Section 05500 and matching other railing supplied for Project.

- 1) Guardrail shall be minimum 42-inch high
- 2) Walking surface:
  - a) Materials: Aluminum grating as specified in Section 05500.
  - b) Location: Over entire bridge and center turntable platform.

D. Influent Pipe

1. A steel influent pipe shall be provided for delivering influent into the feedwell. The pipe shall discharge vertically into the feedwell and be supported from the tank wall.

## 2.04 Center column

A. Materials:

1. Vertically mounted cylindrical Type 316L stainless steel center column:
  - a. Inside diameter: As indicated on the Drawings.
  - b. Wall thickness: 1/4 inch minimum.

B. Design:

1. Support the entire sludge collector mechanism including inboard end of bridge.
2. Size and anchor the entire assembly to be capable of resisting overturning moments when tank is empty or full.

C. Center column anchorage: Mount center column over influent port at center of clarifier. Connect the base flange of the center column to the concrete foundation using anchor bolts:

1. Use a rigid steel template of minimum 1/4-inch thickness to accurately locate anchor bolts for the center column.
2. Supplier shall coordinate with the Contractor to ensure proper anchor bolt location.
3. Center column base anchor bolts:
  - a. Not less than 24 in number.
  - b. Not less than 15 bolt diameters of embedment length.
  - c. Not less than 1/2 inches in diameter.
  - d. Minimum edge distance for anchor bolts shall be the larger of 6 inches or 6 anchor bolt diameters, and as required to clear reinforcing bars located around opening.
4. Center column base mounting flange:
  - a. Size and reinforce using gussets or other stiffeners as necessary to adequately transfer loads from the sludge collector mechanism to clarifier structure.
  - b. Bolt holes in flange to accommodate anchor bolts shall not exceed 1/8 inch plus bolt diameter.

D. Center column outlet ports: Provide outlet ports to disperse influent flow into the feedwell, including the following:

1. Total of 4 ports.
2. An open area of each port not less than 440 square inches.
3. Appropriately reinforced port openings.
4. Other dimensions as indicated on the Drawings.

- E. Flange and stiffen the top of the center column for supporting the sludge collector mechanism, the drive mechanism, and the access bridge:
  - 1. Attach the center column to the drive assembly using bolts.
  - 2. Attach center column to drive assembly using bolts.
- F. Drain holes: Provide two 2-inch holes at bottom to allow column to drain within the tank.

## **2.05 Influent well:**

### **A. Materials:**

- 1. 3/16-inch minimum thickness Type 316L stainless steel plate.
- 2. Reinforced with Type 316L stainless steel stiffening angles where necessary.

### **B. Design:**

- 1. Supported around the outside of the center drive cage using rigid connection. Other methods of connection such as swinging or breakaway supports are not permitted.
- 2. Reduce influent flow energy in a contained area and prevent short-circuiting of flow and provide an exit velocity at maximum flow that will not scour the settled sludge.
- 3. Dimensions: As indicated on the Drawings.
- 4. Equip with a minimum of 4 baffled slots as indicated on the Drawings to allow for removal of floating material in the well.

## **2.06 Rotating Center Drive Shaft and Cone Scraper:**

### **A. General:**

- 1. A rotating steel drive shaft of 1/4" minimum wall thickness shall be provided. The shaft shall be suspended vertically from and receive its rotational power from the center drive unit mounted on the operating platform. The shaft shall extend down to a sludge cone in the center of the tank floor.
- 2. The shaft shall have a steel cone scraper attached to its lower end to prevent deposit of solids in the sludge cone.
- 3. The shaft shall be provided with connections for the two sludge rake arms and feedwell supports. The shaft shall be bolted to the drive unit which shall rotate the shaft with the attached arms and feedwell. The shaft and each arm shall be designed to withstand 150 percent of the design running torque of the drive without over stressing the members. Loading to develop the torque shall be considered as uniform loads applied to each arm individually.
- 4. The rotating shaft shall have adequate structural strength to support the entire rotating mechanism, including rake arms, cone scraper, scum scraper and support, scum skimmer, and feedwell. Design shall accommodate dead load plus live load and torque with an adequate factor of safety to eliminate deflection or vibration.

### **B. Materials:**

- 1. Type 316L stainless steel members.

### **C. Design:**

- 1. Design to carry load from the truss arms plus its own dead load.
- 2. Fasten center drive shaft to spur gear assembly using bolted connection.
- 3. Center drive shaft shall support and rotate the truss arm assemblies with the attached cone scrapers and surface skimming arm.

## **2.07 Sludge collector truss arms:**

### A. Materials:

1. Type 316L stainless steel.

### B. Design:

1. Truss design. Tie rods not permitted.
2. Design with sufficient structural strength to sweep in a layer of grout on the clarifier bottom under its own power.
3. Maintain width of truss arm same as the width of center drive cage to ensure alignment and proper connection.
4. Rigidly connect truss arms to center drive cage.
5. Conform truss arms to slope of tank floor.
6. Use the truss arm to support the segmented scraper blades and scum skimmer arm.

## **2.08 Segmented scrapers and squeegees:**

### A. General: Scraper blades: Setting similar for each truss:

1. Sized and spaced so entire circular portion of tank is scraped twice for each revolution of the mechanism.
2. Having a minimum depth of 9-1/2 inches.
3. Having adjustable squeegees.

### B. Materials:

1. Type 316L stainless steel

## **2.09 Squeegees:**

### A. Materials: Type 316L stainless steel, spring type, not less than 26 gauge thickness.

### B. Projecting approximately 2 inches below the bottom of the segmented scraper blades.

### C. Attach squeegees to blades utilizing stainless steel hardware. Squeegees shall be designed to allow 2 inches of vertical adjustment.

## **2.10 Scum skimming system:**

### A. General: Consisting of a scum skimmer assembly that pushes floating scum to a scum trough for removal. Basic components of skimmer assembly include scum deflector blades and skimmer device:

### B. Scum deflector blades:

1. Material: Type 316L stainless steel plate.
2. Designed to collect and push floating scum radially outward toward the circumferential scum baffle.
3. Extends from the flocculating well to the scum skimmer device.
4. Attached to the rotating collector mechanism at the flocculating well, supported with skimmer assembly supports from the sludge collector truss arms.

5. Attach inner end of deflector blade tangentially to the flocculating well where practicable. Otherwise, provide maximum angle of approach of scum deflector blade to the scum in order to drift the scum to circumferential baffle.

C. Scum skimmer device:

1. Materials: Type 316L stainless steel plate and members.
2. Attach to outer end of the scum deflector blade to trap scum for discharge into scum trough.
3. Size: Full length of the scum trough.
4. Design:
  - a. Maintain continuous contact and proper alignment with scum baffle and inclined scum ramp to positively rake scum to the scum trough.
  - b. Use a hinged blade to move entrapped scum up the scum beach to the scum trough.
  - c. Provide a replaceable wear block on the outer edge of each scum skimmer device.
5. Hinged blade:
  - a. Adjustable vertically to control the dewatering of scum as it travels up the inclined ramp to the scum trough.
  - b. Adjustable vertically over the length to ensure contact with the scum trough even though the trough may not be level.
  - c. Capable of being raised and locked out above the water level or held horizontally against the circumferential scum baffle when skimming is not required.
  - d. Equipped with replaceable scum skimmer wipers on the bottom inner and outer edges to seal the entrapped scum and water when moving up the inclined approach ramp to the scum trough.
6. Scum Flushing Valve:
  - a. A valve shall be attached to the scum box which automatically opens and allows clarified liquid into the scum box to flush out solids. The valve shall actuate at every pass of the scum skimmer over the scum box, allowing sufficient delay after deposit of the solids before flushing begins. Delay and flush duration shall be adjustable. The opening and closing of the scum flushing valve shall be one smooth continuous movement. The valve shall provide 2 to 5 gallons of flush water per each pass of the skimmer assembly.
7. Scum Skimmer Assembly:
  - a. General: A hinged scum skimmer assembly shall be mounted on the outer end of the skimmer blade. The hinged scum skimmer assembly shall be designed to form a pocket for trapping the scum. The hinged arrangement shall insure continual contact and proper alignment between wiper blade, scum baffle, and ramp as the blade travels up the scum box ramp. The wiper blade shall have a wearing strip on its outer end which contacts the scum baffle and a neoprene strip on its lower and inner edge. The neoprene wipers shall be a minimum 1/4-inch thickness. The scum is trapped as the wiper blade meets the ramp and is raised up the ramp to be deposited into the scum trough for disposal.
  - b. Wipers shall be oil resistant neoprene.
8. Wear block:
  - a. Material: Polyvinyl chloride.
  - b. Wear block constantly forced against circumferential scum baffle to keep baffle clean using a coiled spring arrangement.

c. Force between baffle and wear block adjustable between 1 to 5 pounds.

9. Wear block coiled springs:

a. Material: Type 18-8 stainless steel.

b. Enclosed to protect them from the weather.

c. Spring enclosures:

1) Material: Welded Type 316L stainless steel or cast iron housing.

2) Bronze bushed and grease lubricated for easy movement of hinged blades.

D. Scum Box:

1. General:

a. The box shall have a scum trough, vertical steel sides, and a sloping approach ramp that extends from 1-1/2 inches above water level to 5-1/2 inches below. A similar ramp shall be provided at the opposite end to allow the skimmer blade to lower back to the operating position. A flexible connector shall be provided for connection to the contractor supplied scum withdrawal piping in the tank wall.

2. Fabricated from 1/4-inch minimum thickness Type 316L stainless welded steel plate.

3. Supported from clarifier wall by Type 316L stainless steel members.

4. Scum trough:

a. Width: Minimum 3ft.

b. No internal stiffeners or structural members which obstruct scum flow.

c. Standard pipe flanged connection for scum discharge pipe. Size as indicated on the Drawings.

5. Scum beach (inclined approach ramp):

1) Length: Minimum 4ft.

2) Shaped to contain scum as it is moved up the incline to the trough by the scum skimmer.

E. Skimmer assembly supports:

1. Material: Type 316L stainless steel members.

2. Attached to the sludge collector truss arms. Do not support scum skimmer assembly from the scum baffle.

3. Space supports, brought up from the truss arm, at not greater than 10 feet apart.

F. Equipment manufacturer shall size and locate counterweights to be installed by the Contractor.

G. Threaded fasteners: Type 18-8 stainless steel.

**2.11 Drive Unit:**

A. Design Parameters:

1. The drive unit shall be designed and manufactured by the clarifier equipment supplier to ensure unit responsibility. The drive unit shall be designed for the torque values previously listed. It shall turn the mechanism at the design collector tip speed. The drive main bearing shall be designed for the total rotating mechanism loads with a minimum L 10 life of 50 years or 438,000 hours. The drive unit shall be capable of producing and withstanding the previously listed momentary peak torque while starting. The drive main gear shall be designed to a minimum AGMA 6 rating when rated in accordance with the latest AGMA standard. Gear teeth shall be designed for

proper load distribution and sharing. Stub tooth design and surface hardening of the main gear shall not be allowed. The main bearing shall be capable of withstanding the listed overturning moment without the aid of any underwater guides or bearings to ensure correct tooth contact for AGMA rating of the main gear.

B. Physical Characteristics:

1. The drive unit shall consist of a motor, secondary speed reducer, and support base. The drive shall be mounted on the walkway and support the entire rotating load of the mechanism. All speed reducers shall be fully enclosed and running in oil or grease. Support base for the drive shall be of welded steel to assure rigidity. Lubricant and dust seals shall be provided. Lubrication fittings shall be readily accessible.

C. Overload Protection:

1. An overload device shall be provided in a stainless steel, weatherproof enclosure. The device shall be actuated by torque generated from the main drive, which shall operate two independently adjustable switches (the alarm switch at 100 percent of design running torque and the motor cutout switch at 120 percent of design running torque). Devices that require the worm to float and measure the thrust of the worm gear shall not be acceptable. These two switches shall be factory adjusted to accurately calibrate the alarm torque value and the overload position. A visual torque indicator shall be provided and oriented so that it may be read from the walkway. It shall be calibrated from 0 to 160 percent of design running torque.

D. Speed Reducing Unit:

1. The speed reducing unit shall consist of cycloidal, helical, or planetary speed reducers directly connected to a motor without the use of chains or v belts.
2. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing. An eccentric bearing on the high-speed shaft shall roll cycloidal discs of the same material around the internal circumference of this main ring gear. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted then by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.
3. Speed reducer helical or planetary gearing shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage. The speed reducer shall have a minimum service factor of 1.25 based on the output torque rating of the drive.
4. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and be oil or grease lubricated. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.

E. Motor:

1. The motor shall be a squirrel cage, induction type, TEFC, ball bearing heavy duty unit of ample power for starting and operating the mechanism without overload, with a minimum service factor of 1.15.
2. Motor shall be equipped with a 120VAC space heater.

## 2.12 Finishes

A. Shop finishing:

1. Center drive mechanism: Prime and finish paint before shipping to project site.

B. Field finishing:

1. Sludge collector mechanism: For all metal surfaces, except stainless steel or aluminum components, perform surface preparation and coating as specified in Section 09900.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Sludge collector mechanism: Install mechanism and appurtenances as indicated on the Drawings and in accordance with the manufacturer's installation instructions and recommendations.
- B. Field welding:
  1. Field welding is permitted only for the bridge splice.
  2. Use shielded arc welding and conform to requirements of design loads.
- C. Guardrail with kickplate: Install on both sides of walkway and around center turntable as specified in Section 05500.
- D. Scum skimming system: Install counterweights designed and located by manufacturer.
- E. Center column: Mount center column vertically over influent port at center of basin floor.

### **3.02 Field Quality Control**

- A. Testing, training, and start-up: As specified in Section 01756 and the following requirements below.
- B. Tests:
  1. General: Conduct tests in presence of the Engineer.
  2. Working under direction of manufacturer's engineer, perform field tests on each mechanism as follows:
    - a. Cutout torque test:
      - 1) Perform cutout torque test prior to placement of grout topping on concrete slab.
      - 2) The manufacturer shall propose a method of conducting this test and shall verify that the method of testing will not impose stresses in members that exceed allowable stresses.
    - b. Adjustments and settings to overload device:
      - 1) Adjustments and settings: Perform necessary adjustments and settings to overload device to ensure that sludge collector mechanism will sound an alarm and switch off drive motor when specified overload conditions occur in tank.
      - 2) Test run: Perform test run following completion of adjustments and settings of overload device to confirm effectiveness of overload device.
    - c. Dry test run of equipment:
      - 1) Special attention: Give attention during dry test run of equipment to operation of scum skimming device.
      - 2) Settings of skimmer boom to scum box lip and rubber wiping and sealing strips: Set as required to ensure that adequate volume of scum is discharged under normal operating conditions.
- C. Required results:
  1. Sludge collector mechanism:

- a. In the event the mechanism fails to meet field quality control test requirements of this Section, make necessary changes and retest mechanism.
  - b. If mechanism remains unable to meet test requirements to satisfaction of the Engineer, remove and replace such mechanism with satisfactory mechanism at no additional cost.
- D. Manufacturer's field service:
1. Contractor to coordinate field service work with the manufacturer's service representative, Owner, and Engineer prior to initiating such work.
  2. Manufacturer's service representative:
    - a. Manufacturer is to furnish services of representative experienced in erection and operation of the sludge collector mechanism.
    - b. Period of services: The manufacturer shall include in his bid a minimum of three (3) 8-hour days and two (2) trips. The specified durations are the minimum required time on the job site and do not include travel time.
    - c. Services are to include the following:
      - 1) Installation consultation and advice.
      - 2) Checking and supervision of the collector installation.
      - 3) Inspection and certification that unit is ready to sweep in grout prior to grouting operation.
      - 4) Final inspection and adjustments prior to testing.
      - 5) Supervision of testing.
  3. Instruction of personnel on operation and maintenance of equipment.

**\*\*END OF SECTION\*\***

## SECTION 11400 EFFLUENT VERTICAL TURBINE PUMPS

### PART 1 - GENERAL

#### 1.01 Summary

A. This section specifies vertical turbine pump for effluent from the clarifier. The pump manufacturer shall supply both the pump and the drive motor.

#### 1.02 References

A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 300
ASME B16.5	Pipe Flanges and Flanged Fittings
ASTM A48	Standard Specification for Gray Iron Castings
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A108	Standard Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
ASTM A278	Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F (350°C)
ASTM A283	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A516	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate-and-Lower-Temperature Service
ASTM A582	Standard Specification for Free-Machining Stainless and Heat-Resisting Steel Bars
ASTM A743	Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM B148	Standard Specification for Aluminum Bronze Sand Castings
ASTM B505	Standard Specification for Copper-Base Alloy Continuous Castings
ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications

<b><u>Reference</u></b>	<b><u>Title</u></b>
ASTM F593	F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Standard Specification for Stainless Steel Nuts
AWWA E102-06	Submersible Vertical Turbine Pumps
CBC 2019	California Building Code – latest edition
HI 2.1 - 2.2	Vertical Pumps for Nomenclature and Definitions
HI 2.3	Vertical Pumps for Design and Application
HI 2.4	Vertical Pumps for Installation Operation and Maintenance
HI 2.9	Vertical Pump Tests
HI 9.1 – 9.5	Pumps - General Guidelines for Types, Definitions, Application, and Sound Measurement and Decontamination
HI 9.8:	Rotodynamic Pumps for Pump Intake Design
HI 14.6	Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

### **1.03 Definitions**

- A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 2.1-2.2, 2.3, 2.6, and 9.1-9.5 and as modified in the Specifications. The pump head and efficiency are evaluated at the outlet of the discharge head and include the net losses in the pump column and discharge.
- B. Flow, head, efficiency and motor horsepower specified in this Section are minimums unless stated otherwise.
- C. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric.
- D. Tolerances: This Section and related sections contain tolerances that may be more stringent than Hydraulic Institute Standard tolerances. Where tolerances are not mentioned, Hydraulic Institute Standards 2.1-2.2, 2.3, 2.4, and 9.1-9.5 shall apply.

### **1.04 System Description**

- A. Equipment Tag Numbers:

<u>Tag Number</u>	<u>Service</u>	<u>Drawing Reference</u>
P-370	Secondary Effluent from Clarifier #2	I005

- B. General:

1. The pumps shall be designed for pumping secondary effluent. The pumps shall be capable of pumping such fluid without cavitation or damaging vibration within the range of operating conditions specified herein. The pumps shall be suitable for heavy-duty continuous service and capable of intermittent operation.

2. The pumps shall be single or multi-stage, vertical-shaft, enclosed impeller, turbine type with discharge from the pumping element coaxial to the shaft. The pumps shall have open lineshaft and shall be lubricated by the water being pumped. The pumps shall be driven by variable frequency drives.

C. Components:

1. Pump, driver, motors, variable frequency drives, and drive arrangements as specified or as scheduled with shafts, columns, barrels, intermediate bearings, seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves, gauges, taps, lifting eyes, stands, and other items as required for a complete and operational system.

**1.05 Performance Requirements**

A. Pump Schedule:

<b>Tag Numbers</b>	<b>P-370</b>
<b><u>Characteristic</u></b>	<b><u>Value</u></b>
Service	Secondary Effluent
First Named Manufacturer's Model No.	Model 10XKLL
Maximum Noise, dBA at 3-feet	85
Impeller Type	Enclosed
Number of Stages	6
Line Shaft Type	Open
Discharge Shaft Seal Type	Single Mechanical
Column Connection Type	Flanged
Discharge Arrangement	Above Base
Speed Control	VFD
Maximum Motor Speed, rpm	1,770
Minimum Bowl Efficiency at Rating Point, %	76
Impeller Diameter, in	7.09
Minimum Discharge Flange Diameter, in	6
Minimum Column Size, in	6
Rated Horsepower, hp	15
Voltage Rating	480
Frequency/Phase	60/3
Enclosure Type	TEFC
Maximum Net Positive Suction Head Required, ft	6.72
Minimum Suction Static Head, ft	132.5

<b>Tag Numbers</b>	<b>P-370</b>
<b><u>Characteristic</u></b>	<b><u>Value</u></b>
Maximum Suction Static Head, ft	172
Flow, gpm	200
Total Dynamic Head, Ft	200

1. The total head requirements specified above shall be as measured at the discharge of the pump head. Therefore, the pump bowl shall have additional head capacity to accommodate the loss through the pump column and elbow. The design rating condition shall operate within the Hydraulic Institute test load tolerances.
  2. The pump characteristic curve shall be continuously rising towards the shutoff head without dipping.
  3. The best efficiency point on the pump characteristic curve shall be at or to the left of the rated capacity at full speed.
  4. The pumps shall operate at the specified capacities and heads and over the range of operating conditions specified without cavitation, undue noise, or vibration.
- B. Hydrostatic Test: Each pump shall be subjected in the shop to a hydrostatic test. The test pressure shall be not less than 1-1/2 times the shutoff head of the pump as shown by the characteristic curve. Under this test pressure, no part shall show undue deflection or sign of weakness or other defects.

### **1.06 Submittals**

- A. The Contractor shall provide the following submittals, in accordance with Section 01300 - Submittal Procedures and submittal 15020 – Basic Mechanical Requirements.
1. Shop drawings for each unit.
  2. Manufacturer’s pump curve and product data.
  3. Outline installation drawings for each unit.
  4. Material list(s) and catalog information showing the details of construction.
  5. List(s) of recommended Spare Parts and Special Tools.
  6. Seismic anchorage requirements per Section 01612 – Seismic Design Criteria.
- B. Manufacturer’s Instructions and Field Reports: In accordance with the requirements of Section 11010 - General Requirements for Equipment instructions for installation and testing of equipment shall be provided with equipment submittals. A manufacturer’s certification letter shall be submitted in accordance with Section 01660 - Testing and Startup.
- C. Operation and Maintenance: In accordance with Section 11010 - General Requirements for Equipment paper or electronic copies of the primary equipment Operation and Maintenance manuals shall be submitted for information with the initial equipment submittals. This is in addition to the information that shall be submitted in accordance with Section 01360 - Operating and Maintenance Information.
- D. Motor radial and thrust bearings selected and their ABMA L-10 rating life for continuous operation conditions of service.

- E. Motor radial and thrust bearings selected and their ABMA L-10 rating life for continuous operation conditions of service.
- F. Reed Critical Frequency Calculations showing the discharge head and motor structure will not have any natural frequencies within 20% of the operating speed range.
- G. Bill of materials.

### **1.07 Quality Assurance**

- A. General: Pumps shall be capable of continuous operation while pumping plant water and recycled water.
- B. Single Source Responsibility: Pumps specified in this Section shall be by one manufacturer.
- C. Require pump manufacturer to furnish and coordinate pump, driver, drive, and pump components including barrel/can as scheduled and to provide written installation and check out requirements. as specified and scheduled and to provide written installation and check out requirements.
- D. The motor manufacturer's certification of motor compatibility with specified variable speed control systems specified in Division 16 – Electrical.
- E. Factory Capacity Test:
  - 1. A shop test shall be performed on each pumping unit of each size in accordance with the test code of the Hydraulic Institute, except as modified herein. The pump shall be tested in the position that it will be installed. During the test, the pump shall be driven by its own motor. The pump shall be tested at the full load operating speed of the drive unit as determined by the tests.
  - 2. The tests shall be run at rated operating speed and lowest operating speeds, and shall be sufficient to determine the curves of capacity, electric input horsepower, water output horsepower, and overall efficiencies for heads from shutoff to the minimum specified head for the pumping units. Sufficient test data shall be submitted to enable computation and plotting of curves for brake horsepower and pump efficiency. A minimum of ten (10) points of rated and lowest operating speeds shall be taken: as near as possible to each specified condition of head and discharge; at or slightly above the maximum head specified; and at one-half the minimum head specified. Discharge shall be expressed in gallons per minutes on the curves. Reduced speed curves shall be generated based on the affinity laws for centrifugal pumps. The curves shall be stamped by a California Registered engineer.
  - 3. Certified copies of the curves showing the results of the shop tests, along with drive unit test data, shall be furnished to the Engineer for approval. Shipment of the pumping units shall not be made until the Engineer has approved the test data and curves.
- F. Manufacturer's field service:
  - 1. Furnish services of authorized representative specially trained in installation of equipment:
    - a. Visit project site and perform tasks necessary to certify installation.
    - b. Furnish Certificate of Proper Installation.

### **1.08 Project/Site Conditions**

- A. The pumps and motors furnished under this section will be installed at the location shown on the drawings and shall be suitable for the service specified. The pumped fluid temperature is expected to range from 35 degrees F to 85 degrees F.
- B. The ambient temperatures at the site are expected to range between 31 degrees F and 85 degrees F with relative humidity which varies from 17 to 35 percent.

C. Project Elevation: Project Site is located at 4,000 ft ± above mean sea level.

### **1.09 Delivery, Storage, and Handling**

A. Packing and shipping:

1. Equipment: Pack in boxes, crates, or otherwise protect from damage and moisture, dust, or dirt during shipment, handling, and storage.
2. Bearings: Separately pack or otherwise suitably protect during transport.
3. Spare parts: Deliver in boxes labeled with contents, equipment to which spare parts belong, and name of CONTRACTOR.

B. Storage:

1. Equipment having bearings: Store in enclosed facilities. Rotate units at least once per month or more often as recommended by the manufacturer to protect rotating elements and bearings.
2. Gear boxes: Oil filled or sprayed with rust preventive protective coating.

C. Protection:

1. Equipment: Protect equipment from deleterious exposure.
2. Painted surfaces: Protect against impact, abrasion, discoloration, and other damage.

### **1.10 Warranty**

- A. The manufacturer shall furnish the Owner with a written warranty to cover the pumps against defects in workmanship and material for a period of one year and rotating parts for a period of five (5) years under normal use and service from the date of acceptance of installation by the manufacturer's representative.
- B. The manufacturer shall furnish the Owner with a written warranty to cover pumps against defects in workmanship and material for a period of one year under normal use and service.
- C. The manufacturer's warranty shall be issued in the Owner's name.

### **1.11 Maintenance**

- A. Special Tools: Deliver 1 set of special tools required for complete assembly or disassembly of pump system components for each type or size of pump specified.
- B. Spare Parts: Pack and label the following for warehouse storage. Deliver to Owner for each type or size of pump specified:
1. Line shaft bronze bearings: One set for each type pump.
  2. Mechanical seal: One complete seal of each type.
  3. Set of gaskets and o-rings for each pump.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Pumps shall be as manufactured by the following:
1. Floway (as scheduled),
  2. Flowserve (Similar to scheduled model),

3. Simflo (Similar to existing pump model),
4. or approved equal.

## 2.02 Materials

A. Materials for the vertical turbine pumps shall conform to the following requirements:

<u>Component</u>	<u>Material</u>
Suction Case and Bowl Assembly	Cast iron, ASTM A 48 Class 30, minimum.
Impeller	Bronze, ASTM B584
Pump Bearings	Tin Bronze, C90300
Bowl Bearing	Bronze, C84400
Bowl Shaft, Lineshaft, and Couplings	Stainless steel, ASTM A 582 Type 416
Pump Bowl	Cast iron, ASTM A 48 Class 30, Minimum
Pump Column	Steel, ASTM A53, Grade B
Lineshaft Bearing	Tin Bronze, C90300 or Rubber Buna N
Lineshaft Material	Stainless Steel, ASTM A 582 Type 416
Discharge Head and Support Plate	Fabricated Steel, ASTM A36
All exposed nuts, bolts and fasteners	Stainless steel, AISI Type 316

## 2.03 Components

A. General

1. Discharge flange: ASME B16.1 or B16.5 drilled; rated for 1.2 times the pump shutoff head at 150 degrees Fahrenheit.
2. Discharge nozzles: Provide 1/2-inch NPT taps for pressure gauges; install nipple and gauge with block valve. Provide Nozzle connections and pump can air relief valve assemblies sized by the manufacturer according to the expected air exchange rate and pressure.
3. Bearings: Design driver/motor, right angle gear or other drive arrangement bearings to support the line shaft assembly and rated for ABMA L10 life of 40,000 hours at Design Rated Point flow and head in accordance with ABMA 9 or ABMA 11 design motor or right angle gear thrust bearing to withstand continuous duty full load thrust and momentary upthrust that may occur during pump on/off or other operations.
4. Motor shall be equipped with a 120VAC space heater.

B. Impellers:

1. Impellers shall be mounted on their shafts and shall be statically and dynamically balanced prior to final assembly.
2. Type: enclosed.
3. Casting: One piece, free of cracks, and porosity. Each impeller shall be free of sharp projections, cavities, or abrupt transitions that could encourage or incite cavitation or excessive turbulence.
4. Impellers shall be securely fastened to their shafts with locking collets.

5. Balance: As specified in Section 11010-General Requirements for Equipment and shall be evenly balanced to minimize vibration and excessive wear.
6. Vibration Criteria: As per manufacturer's recommendations.
7. Wear rings on each impeller are not required.

C. Bowl Assembly:

1. The pump bowl inlet shall be designed to provide conservative entrance velocities and direct the flow to the impeller.
2. The inner surfaces of the inlet shall be smooth and free of sharp projections or cavities that might cause turbulence or cavitation.
3. A streamlined housing, centered and held in the bell by means of rigid vanes, shall be provided to properly direct the flow to the impeller.
4. Method of securing impellers to shafts: For pumps 18-inch and smaller, provide taper fit collets for mounting the impeller. For larger pumps, use a double keyed arrangement. Provide any special tools required for removal and installation of pump impellers.
5. Each bowl shall be provided with a wear ring. Design replaceable wear rings for both the bowl and impeller on each impeller bowl.
6. Design capable of passing solids with a sphere size as scheduled or larger.
7. Design impellers capable of working on pumps that may be abnormally started against closed manual valve or normally against a closed pump control valve.
8. Linings:
  - a. The inner surfaces of the pump bowls and inlet bell shall be lined with vitreous enamel epoxy.
  - b. The exterior shall be coated with a minimum of 12 mils of epoxy and painted in accordance with Section 09900 – Coating Systems.
  - c. The interior of the bowl assembly shall be lined with fusion bonded epoxy 3M Scotchkote 134, alternatively, the bowls may be lined with the pump manufacturer's pre-approved lining. The exterior of the bowl assembly shall be coated with epoxy Tnemec Pota Pox 140 or equal.
9. The bowl assembly shall be fitted with a 316 stainless steel clip-on basket strainer.

D. Shafts:

1. Shafts shall be of ample size to operate without distortion in both the forward and reverse direction and shall have a first critical speed not less than 10 percent above maximum operating speed and 1.5 times the maximum operating torque. Sections of shafting rotation in bearings shall be with a hardened stainless steel sleeve.
2. Shaft and couplings: Provide flanged shaft couplings with key or set screw locking of shaft couplings. Design driver to pump line shaft coupling of sufficient length and strength to maintain line shaft alignment.
3. Shaft bearings and spiders: Provide bearings and retainers as scheduled, but not to exceed 10 feet.
4. Materials: As scheduled; when not scheduled provide:
  - a. Shaft and couplings: ASTM A 108, Grade 1045 steel with ASTM A 276, Type 316 hardened stainless steel journal or sleeve at each bearing.

b. Shaft bearings and spiders: ASTM B 584, Alloy C83600 leaded red brass bearings; Neoprene rubber spider on enclosing tube.

5. Enclosing tube: Steel pipe, ASTM A 53, Grade B unless scheduled otherwise.

E. Bearings:

1. Lineshaft bearings shall be material, as scheduled. The bearings shall be spaced not more than five (5) feet apart.
2. Lower bowl guide bearings on the first stage shall be grease lubricated.
3. All other bowl guide bearings, except the first stage, shall be lubricated by the water being pumped.

F. Discharge Columns:

1. Discharge columns shall be fabricated of steel, round in section, and fitted with lineshaft bearing housings spaced not more than five (5) feet apart. Sections of columns shall not exceed five (5) feet in length and shall be joined with flanges. Lineshaft bearing housings shall be held by rigid spiders securely anchored to the discharge column.
2. The interior of the column shall be free of offsets, burrs, discontinuities, and irregularities.
3. Column pipe shall be lined and coated with NSF-61 certified fusion bonded epoxy to 12-mils minimum. Bearing retainers integral to the column pipes shall also be coated.

G. Protection:

1. The interior of the discharge column and all exterior below grade surfaces of the column and pump bowl shall be protected with an epoxy coating.
2. A sacrificial anode shall be provided on the bowl assembly or on the first column section.

H. Discharge Head and Drive Unit Support:

1. The discharge head shall be of the aboveground type, fabricated of steel. The pump discharge shall be fitted for connection with flanged pipe coupling as shown.
2. All couplings and other moving or rotating parts shall be covered on all sides by an OSHA approved coupling guard. Coupling guards shall be fabricated from 16 USS gage or thicker aluminum-clad steel or from 1/2 inch mesh expanded metal. Each guard shall be designed for easy installation and removal. The discharge head shall be designed to carry the weight of the complete pump and drive unit and resist seismic forces without distortion. The pump manufacturer shall coordinate the pump head discharge elevation with the drawings to facilitate change out of the pumps in the future to larger size pumps.
3. The discharge head shall be supported by a separate fabricated steel base (sole plate) designed to carry the weight of the complete pump and drive unit and resist seismic forces without distortion. The pump manufacturer shall coordinate the pump head discharge elevation with the drawings to facilitate change out of the pumps in the future to larger size pumps.
4. The manufacturer shall furnish calculations showing that the fabricated discharge head and motor combination will not have a structural or reed critical anywhere from 20 percent above the maximum speed to 20 percent below the minimum speed of the pump.
5. The drive unit support shall be fabricated of steel and shall be designed to accommodate the equipment specified. The discharge head shall be heat treated after fabrication to relieve residual stresses. Heads shall be welded to meet requirements of ASME Boiler Code, Section 9.

6. All interior wetted surfaces of the discharge head shall be coated to 12-mils minimum dry film thickness (DFT) with a fusion bonded epoxy. The exterior of the head shall be coated to 8-mils minimum with high performance epoxy Tnemec Pota Pox 140 or equal.

I. Couplings:

1. Lineshaft coupling shall be a perfect butt-fit for the shaft that shall be designed with a safety factor of 1½ times the shaft safety factor and shall have a left-hand thread to tighten during pump operation. The motor shaft shall be coupled to the pump shaft using a rigid flanged adjustable spacer type Coupling (FASC). The spacer shall be of sufficient length to allow the mechanical seal to be removed without disturbing the motor. This coupling shall allow for the vertical adjustment of the shaft mounted impellers.

J. Shaft Seal:

1. Shaft seal shall be inside, cartridge mounting, balanced mechanical seal. It shall have carbon stationary face and silicon carbide rotating face. Gland plate shall be stainless steel. Arrangement of the seal shall be such that it may be serviced or replaced without removal of the pump motor. The seal shall be Chesterton Model 123, no substitute. The pump shall have provisions to collect any leakage from the shaft seal and drain back to the pump can through tubing.

## 2.04 Drive Unit

A. Provide drive motors per Division 16 requirements.

B. Arrangement: Vertical, Coupled

C. Horsepower:

1. As scheduled.
2. Listed driver horsepower is the minimum to be supplied.
  - a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
  - b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
  - c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower at no cost to the owner.

D. Motors:

1. RPM: As scheduled:
2. Enclosure: TEFC.
3. Electrical characteristics: As scheduled.
4. Efficiency, service factor, insulation, and other motor characteristics: As specified in section 11060.
5. Motor accessories: As specified in Section 11060 and as herein.
6. Coordinate motors with the variable frequency drive manufacturer to ensure compatibility between the motor and variable frequency drive.

E. Non-reverse Ratchets are required.

F. Manufacturers:

1. Baldor

2. or Approved Equal.

G. The drive unit shall be provided with a temperature sensor for motor protection wired to a thermostat mounted on the unit.

## **2.05 Controls**

A. Controls shall be provided in accordance with Division 16 requirements.

## **2.06 Finishes**

A. All coatings and linings shall be applied in accordance with each coating manufacturer's written instructions.

B. Color: In accordance with the City's color scheme for public works piping systems.

C. Provide Tnemec Pota-Pox for interior and exterior coating/linings.

## **PART 3 - EXECUTION**

### **3.01 Installation**

A. Equipment shall be installed in strict conformance with the drawings and the manufacturer's installation instructions and recommendations.

### **3.02 Field Quality Control**

A. Perform Field Testing, Start-up and Demonstration in Accordance with the requirements of Section 01660 and additional requirements stated herein:

B. Field Inspection

1. After the installation of the units and all appurtenances, each unit shall be subjected to a field running test under actual operating conditions. The field tests shall be made by the Contractor in the presence of and as directed by the Construction Manager. The field tests shall demonstrate that under all conditions of operation each unit:

a. Has not been damaged by transportation or installation.

b. Has been properly installed.

c. Has no mechanical defects.

d. Is in proper alignment.

e. Has been properly connected.

f. Is free of overheating of any parts.

g. Is free of all objectionable vibration.

h. Is free of excessive noise.

i. Is free of overloading of any parts.

j. Shall operate as specified with the control system.

k. Meets the performance requirements indicated.

l. Any defects in the equipment or failure to meet the requirements of the Specifications shall be promptly corrected by the Contractor.

C. Field Testing

1. Hydrostatic Performance Test:
  - a. For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.
  - b. Operate at rated design load conditions.
  - c. Confirm that equipment is properly assembled, equipment moves or rotates in the proper direction, shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances, and that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
  - d. Pump Performance Test:
    - 1) Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at a reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
    - 2) Use actual driver for field tests.
    - 3) Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.
    - 4) Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.
  - e. Vibration Test:
    - 1) Test requirement:
      - a) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.
      - b) Vibration spectra versus frequency shall be in accordance with Factory Acceptance Test Vibration Acceptance Criteria.
    - 2) Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.
  - f. Level 2 Noise Test:
    - 1) Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.
  - g. Submit a separate report confirming installation under similar criteria listed for factory testing.
2. Start-up: Manufacturer shall inspect system before initial start-up and certify that system has been correctly installed and prepared for start-up.

### **3.03 Manufacturer's Representative**

- A. A qualified manufacturer's representative shall inspect the installation of the equipment, make any necessary adjustments, test and place the equipment in satisfactory operating condition. The manufacturer's representative shall also instruct the plant operating personnel in the operation and maintenance of the equipment.

- B. Manufacturer's qualified representative shall provide the requisite services (Inspection, Startup, and Training) for the minimum of sixteen (16) hours shall be provided, travel time excluded:
- C. Training details to be submitted three (3) weeks prior to scheduled training. The training session time and date shall be scheduled with the Owner through the Construction Manager.

**\*\*END OF SECTION\*\***

# SECTION 11410 BLOWERS

## PART 1 - GENERAL

### 1.01 Summary

A. This Section specifies the positive displacement blower system. The blowers shall provide required air for the sludge digesters.

### 1.02 System Description

A. Equipment Tag Numbers:

<u>Tag Number</u>	<u>Service</u>	<u>Drawing Reference</u>
B-610	DIGESTER BLOWER #1	I002
B-620	DIGESTER BLOWER #2	I002

B. The equipment manufacturer shall be experienced in manufacturing blower equipment of this technology as specified and have a record of successful in-service performance. Manufacturer must have at least ten (10) years experience with (20) similar facilities in operation.

### 1.03 Performance Requirements

A. Each blower shall meet the following sizing and performance requirements:

1. Blowers shall be installed in duty, standby arrangement at a site elevation of 4,000 feet.
2. Sized and configured to achieve uniform aeration of waste activated sludge to promote aerobic digestion under the specified operating conditions.
3. Motors shall be 15 HP max, 460 volts, 3 phase, and 60 hertz.
4. Provide a minimum airflow requirement of 30 SCFM and a maximum airflow requirement of 120 SCFM per blower with the capacity to expand capacity of blowers to 150 SCFM in the future.
5. Provide a minimum of 10 PSIG discharge head from the blowers to the digesters.
6. Blowers shall be suitable for continuous operation at the conditions stated herein without excessive noise, vibration, heating or any damage to blowers.

### 1.04 Site Conditions

A. Blowers, motors, and control equipment shall be designed for continuous duty at an elevation of 3700 FT above mean sea level. The ambient temperature is expected to range from 20 degrees F to 100 degrees F.

### 1.05 Submittals

A. The Contractor shall provide the following submittals, in accordance with Section 01300 - Submittal Procedures and submittal 15010 – Basic Mechanical Requirements.

1. Shop drawings, material list, and catalog information showing the details of blower construction.
2. Outline installation drawings for each unit.
3. Equipment operating characteristics.
4. Electrical characteristics.

5. Bill of materials.
6. List(s) of recommended Spare Parts and Special Tools.
7. Annotated Manufacturer's catalog cut sheets listing materials of construction, performance curves/charts, standards of design;
8. Warranty statement;
9. Coating system plus the following:
  - a. Design: Supplier shall provide a design worksheet for every blower which models the following:
    - 1) Dynamic Water levels for all chambers/basins
    - 2) All blower pipe networks with friction coefficients
    - 3) All blower fittings
    - 4) All blower valves, orifices, gates.
    - 5) Blower Curve Layover
  - b. Blower
    - 1) BHP at: normal system operating conditions.
    - 2) Discharge temperature at ambient temperature and normal system operating conditions.
    - 3) L10 bearing life calculations for each bearing.
  - c. Motor
    - 1) 1/2, 3/4, full load efficiencies and power factors.
    - 2) L10 bearing life calculations for each bearing.
  - d. Silencers
    - 1) A certified attenuation performance curve for each type of silencer.
  - e. Pressure Relief Valve
    - 1) Set pressure.
    - 2) Shop drawings of assembled system stating what items will be shipped to the job site assembled and those shipped loose for field assembly.
    - 3) V-belt drive calculations.
  - f. Blower Criteria
    - 1) Submit the following information for each blower to be provided in the system:
      - a) Service Application.
      - b) Maximum Inlet Temperature, °F.
      - c) Maximum Relative Humidity, %.
      - d) SCFM.
      - e) Differential Pressure, PSIG.
      - f) Maximum BHP Required.
      - g) RPM Limit at above SCFM.
      - h) Motor Size.

i) Attenuated Sound Produced at 3 feet distance in all directions from Blower.

- B. Manufacturer's Instructions and Field Reports: In accordance with the requirements of Section 11010 - General Requirements for Equipment, instructions for installation and testing of equipment shall be provided with equipment submittals. A manufacturer's certification letter shall be submitted in accordance with Section 01660 - Testing and Startup.
- C. Operation and Maintenance: In accordance with Section 11010 - General Requirements for Equipment, paper or electronic copies of the primary equipment Operation and Maintenance manuals shall be submitted for information with the initial equipment submittals. This is in addition to the information that shall be submitted in accordance with Section 01360 - Operating and Maintenance Information.

### **1.06 Quality Assurance**

- A. The blower system(s) shall be built by a blower system manufacturer who has units at 50 or more wastewater treatment plants, the same size or larger than those specified herein, that have been in successful operation for fifteen or more years. Submit demonstration of compliance with this requirement.
- B. All blower components shall be furnished by a single manufacturer.
- C. Blowers, motors, and all primary components shall be manufactured in the United States/North America with replacements and parts available from multiple sources within the United States.
- D. Blower package(s) shall ship fully crated.
- E. Factory Testing
  - 1. Each blower shall be tested at the factory for correct operation, lubrication, operating temperature, and proper assembly. Upon request, a test sheet certifying suitable operation shall be shipped with each blower.

### **1.07 Warranty**

- A. The blower manufacturer shall guarantee in writing the units free of defects in material workmanship for a period of at least 5 years from the date of initial operation under the operating conditions specified.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Blowers shall be as manufactured by the following:
  - 1. Universal Blower Pac, Inc.,
  - 2. Or Approved Equal

### **2.02 Blower**

- A. The blower shaft shall be one piece, separate or cast integrally with the impellers. Blowers shall be dynamically balanced and provide oil free non-contact compression.
- B. Blower housing shall be powder coated aluminum and galvanized steel. Enclosure ventilation shall be accomplished with a separately wired 120V ventilation fan with thermostat.
- C. Impeller to be of solid-cast ductile-iron helical construction.
- D. Lubrication: bearings to be permanently sealed bearings and shall not require periodic greasing

- E. Units shall hold CE mark.
- F. Motor to be integrally mounted to blower housing.

### **2.03 Attenuation**

- A. Each blower shall be no louder than 68 dBA at a distance of 3 feet from the unit on any side.
- B. Each blower system shall be equipped with an acoustical enclosure. The enclosures shall be designed, assembled and inspected at the manufacturing site with documentation provided to verify compliance. Noise attenuation shall be provided as necessary to achieve a noise level at or below the specified sound limit at a distance of 3 feet from the operating equipment in a free field environment. All readings shall be taken by personnel experienced in the field of sound attenuation.
- C. The enclosure shall be designed and manufactured by the blower system manufacturer specifically for the equipment supplied. Units shall be designed to be picked up by a fork truck. Each acoustical enclosure shall be shipped completely assembled. No field assembly shall be permitted.
- D. Absorption of sound waves shall be the basis of design for the enclosure. The complete blower system will be enclosed to meet the level specified. With absorption considered, perforated metal inner skin retaining devices shall not be considered acceptable.
- E. Absorption media shall be a nominal 2-inch thick resilient material capable of returning to its original form after compression. Media shall have an overall weight of not less than 1.6 pounds per cubic foot. Media sheets shall have an upper oil resistant layer a minimum of three mils in thickness to protect the integrity of the media. Absorption media shall be interior and be fitted to each exterior facet and show contact at all points. Media shall be snug fit, be complete with pressure sensitive adhesive and held in place with washers, studs and cap nuts manufactured from corrosive resistant materials. All adhesives used in anchoring studs or other items in structure shall be high temperature industrial material rated for the application.
- F. Outer skin shall be a minimum 14 gauge galvanized steel. Enclosure panels to be 10 gauge aluminum. Lesser gauges shall not be acceptable. All surfaces are to be fusion bonded epoxy coated for exterior installations adjacent to hazardous environments and resistant to hydrogen sulfide gas.
- G. Enclosure panels shall be constructed in a manner so that all fastening hardware shall not be visible on the exterior of the enclosure. Rivets or loose fitting panels which can loosen during operation will not be accepted. Slide-in panels showing a loose fit shall provide grounds for rejection. Panels shall be constructed as to compress media on installation providing tightness and maximum sound absorption.
- H. Each enclosure will have removable service panels. All surfaces and edges shall be free of burs and sharp edges. Doors shall lock closed using ½ turn telescoping “T” handles flush mounted to the enclosure panels.
- I. Each enclosure shall incorporate internal vent boxes rated for the SCFM listed in the "service" section and discharge pipe openings with sound seal. Louvers shall not be acceptable.
- J. All maintenance shall be performed from the front of the enclosure. Side and rear maintenance access is not necessary.
- K. A 120/60/1 electric cooling fan with thermostat control and acoustical vent shall be supplied installed on the enclosure. To ensure adequate cooling at all speeds the cooling fan will not be connected to the blower or motor shaft in any way.

### **2.04 Motor**

- A. Blower motors to have the following minimum criteria:

<b>Parameter</b>	<b>Specification</b>
Design	TEFC, Tropicalized, CURUS marking from UL.
Horsepower	Nameplate greater than the BHP at 10% above the relief valve set pressure
Type	TEFC
Power	480 Volt, 3-Phase, 60 Hertz
Insulation	Class F with Class B Rise
Service Factor	1.0 if used with VFD
Efficiency	Premium Efficiency per latest edition of NEMA MG1

### **2.05 Variable Frequency Drive**

- A. The motor will be designed, constructed, warranted for two year operation by a constant-torque variable frequency drive suitable for the air flow requirements. The insulation shall meet or exceed the current NEMA MG1-31.4.4.2 and have a Class F thermostat in each phase. Motor and variable frequency drive must be capable of starting, accelerating and maintaining compressor operating speed within the specified operating range on a continuous basis without overheating.

### **2.06 V-Belt**

- A. High-capacity type, oil and heat resistant, static-dissipating drive belts selected to have a 1.4 or higher service factor above the required blower brake horsepower. Sheaves shall mount to the blower and motor shafts with QD type bushings.

### **2.07 Drive Guard**

- A. Top, sides and bottom made of 14 gauge sheet steel with expanded metal front and back. Designed to allow ample ventilation for the drive, have an easy access cover and conform to applicable safety codes.

### **2.08 Base and Anchorage**

- A. Base shall include spring loaded auto-tension device for ease of drive installation and maintenance. Covered forklift slots shall be integral to the base design. In order to reduce stress and vibration in base caused by thermal expansion and attenuation, discharge silencer shall not be integral to the base.
- B. The blower base shall be mounted on vibration mounts to minimize transmitted vibrations from the blower system to the surrounding structure.
- C. Anchor bolts shall be 316L stainless steel, designed and sized specifically for dynamic loading.

### **2.09 Accessories**

- A. Inlet Filter/Silencer
1. Each blower will have a filter/silencer with paper media that removes 99.5% of 2 micron particles. The maximum pressure drop across the clean element shall be less than 2-inches of water column. The filter/silencer shall be Stoddard FH64 or equal.
- B. Discharge Silencer

1. Silencers shall be of the helical-flow design and separate from the base frame. Air velocity shall be 5500 to 7000 feet per minute. Silencer shall be Universal Series CB or equal.

#### C. Flexible Joints

1. Each blower shall have a flexible joint located between the blower and discharge silencer to minimize vibration transmission to downstream piping. The joint's elastomer must be rated higher than the maximum expected service temperature and pressure.
2. Each blower shall have an external discharge flexible joint that matches the blower discharge silencer size. The joint's elastomer must be rated higher than the maximum expected service temperature and pressure. The flexible joint shall ship installed on the system.

#### D. Valves

##### 1. Pressure Relief Valve

- a. Each blower shall be protected by a spring loaded pressure relief valve preset to start opening at half a PSIG above the PSIG listed in the performance requirements section, be full open at not more than 10% above the set pressure, and rated for the SCFM and PSIG listed in the performance requirements section. If the valve malfunctions it shall do so in the open condition to prevent blower damage.

##### 2. Check Valves

- a. Each blower shall have a discharge check valve. Valves 6-inch and smaller shall have a NPT steel body. Valves 8-inch and larger shall have a cast-iron wafer body. Internals shall be aluminum split discs with no-pinch elastomer and seal rated above the maximum anticipated discharge temperature. Valve shall be shipped installed on the system.

##### 3. Isolation Valve

- a. Each blower shall have a discharge isolation valve. Valves less than two inches in diameter will be ball valves. Valves 2-inches and larger shall be stainless steel T/C butterfly valve with a locking handle. The temperature rating of the seat must exceed the maximum anticipated discharge temperature. The valve shall be shipped installed on the system.

##### 4. Blow Off Valve & Silencer

- a. Each blower shall have an open to atmosphere blow-off valve with actuator & silencer.
- b. The valve will automatically be closed after the motor has reached operating speed by a 120/1/60 electric actuator. The valve shall be Keystone model 221 or equal.
- c. A silencer shall be supplied with each blow-off valve to mitigate high frequency noise. The silencer shall be high grade type, rated for venting applications. The silencer shall be Universal Silencer model SU5 or equal. The unloading valve and silencer shall be two pipe sizes larger than the pressure relief valve's inlet port. The valve and silencer shall ship loose for field installation.

##### 5. Instruments

###### a. Pressure Gauge

- 1) Each blower shall have a 4" diameter, stainless steel case, brass bourdon tube, liquid filled, 1/4 NPT connection pressure gauge with a 0-15 PSIG scale on systems operating up to 10 PSIG and 0-30 PSIG for higher pressures. Gauge shall have a 1/4" brass snubber and isolation valve.
- 2) Gauge shall be Winters 738 or equal.

###### b. Filter Restriction Gauge

- 1) Each inlet filter/silencer shall have a gauge, with isolation valve, to measure vacuum in the filter element. The gauge shall have a visual indicator to lock at the current vacuum when the blower is shut off and have a manual reset. Gauge shall be mounted in the enclosure wall. Gauge shall be Dwyer Magnehelic or equal.
- c. Thermometer
  - 1) Each blower shall have a 4.5" diameter thermometer with a 50-300 degrees F scale on systems up to 10 PSIG, 50-500F for higher pressure. Thermometer shall be mounted in the enclosure walls. The thermometer shall be Wika TI.V45RB or equal.
6. Replacement Parts
  - a. Each blower shall be furnished with the following spare parts:
    - 1) One spare filter element,
    - 2) One set of spare V-belts,
    - 3) Lubricants for start-up (6 months, 1 year)
7. Coatings
  - a. Equipment shall be cleaned to SSPC-SP 3 and receive a 2-3 mil DFT shop coat of phenolic alkyd, zinc-chromate, red iron oxide, rust inhibitive universal primer. The systems shall then receive a finish coat of Coronado Alkyd Enamel, 139 series, 50% gloss, high temperature paint. The coat shall be 5-10 mil DFT.
  - b. Enclosures shall be powder coated with a coating that is highly resistant to UV rays and weather. Tiger Drylac Series 38 super durable or equal.
8. Manuals
  - a. One operation and maintenance manual shall be provided for each size of blower.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. The units shall be installed and leveled per the manufacturer's instructions supplied in the O&M manual.

### **3.02 Testing and Demonstration**

- A. Upon completion of work and adjustment of all equipment, test systems to demonstrate to Owner's Representative and Engineer that all equipment furnished and installed or connected under provisions of these Specifications functions mechanically in the manner required.
- B. Testing and Demonstration shall adhere to the requirements specified under Sections 01660, 11070, 17512 and those listed herein.
- C. Testing and Demonstration of blowers shall include the following:
  1. Factory Acceptance Testing (FAT)
  2. Site Acceptance Testing (SAT)
    - a. Inspect components for proper installation, wiring and piping.
    - b. Operate all components and check for proper operation in coordination with the Manufacturer, Engineer and Owner's representative.
    - c. Make necessary adjustments during startup and testing.

- d. Log all activity for review and Approval by the Engineer.
  - e. Blowers equipment shall be field operated and tested under maximum operating conditions to confirm that each blower operates per design with no vibration or operational issues.
  - f. Field testing shall be witnessed by the Manufacturer or Manufacturer's representative whom will certify the installation and provide a written statement designating that the equipment has been successfully installed and operates per the manufacturer's requirements such that the Factory Warranty is not compromised.
3. Demonstration
- a. The Supplier shall provide field maintenance and quality assurance during the demonstration period prior to successful completion and public acceptance. Should defects arise, the Supplier shall provide services to successfully correct all related issues to the extent required by the Engineer.

### **3.03 Manufacturer's Representative**

- A. A qualified manufacturer's representative shall inspect the installation of the equipment, make any necessary adjustments, test and place the equipment in satisfactory operating condition. The manufacturer's representative shall also instruct the plant operating personnel in the operation and maintenance of the equipment.
- B. Manufacturer's qualified representative shall provide the requisite services (Inspection, Startup, and Training) for a minimum of eight (8) hours, travel time excluded:
- C. Training details to be submitted three (3) weeks prior to scheduled training. The training session time and date shall be scheduled with the Owner through the Construction Manager.

**\*\*END OF SECTION\*\***

## **SECTION 15010 BASIC MECHANICAL REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.01 Summary**

- A. Work Included: The work included in this Section applies to all Division 15 work to provide all materials, labor, tools, permits and incidentals to provide and make ready for the Owner's use for the proposed project.
- B. Related Work Specified Elsewhere:
  - 1. The content of this Section applies to all Division 15 Specifications.
  - 2. The requirements of this Section are a minimum for each Division 15 Section, unless otherwise stated in each Section, in which case that Section's requirements shall take precedence.

#### **1.02 Quality Assurance**

- A. Where any of the Contract Documents are at variance with the applicable codes governing the work, the code requirements shall take precedence, and include any cost necessary for code compliance in the bid price.
- B. Mechanical Drawings:
  - 1. The Drawings are intended to be diagrammatic and are based on one manufacturer's equipment. They are not intended to show every item in its exact dimensions, or all the details of the equipment or proposed systems layout. Verify the actual dimensions of the systems (i.e., ducts and piping) and equipment proposed to assure that the systems and equipment will fit in the available space.
  - 2. Installation of all mechanical systems within the limitations imposed by the architectural, structural, mechanical, and electrical requirements. Provide adequate space for manufacturer's recommended maintenance and code required clearances.
- C. Substitutions:
  - 1. Where materials or equipment are specified by name of manufacturer, such Specification shall be deemed to be used for purposes of establishing a standard of quality for that particular item. Materials or equipment shall conform to the Specifications and Drawings in all respects. Modification to equipment to conform to the Specifications or Drawings is required if the listed manufacturer cannot meet the requirements with a regularly cataloged item. Inclusion of a company name as acceptable manufacturer to provide specific equipment does not indicate that the manufacturer's standard cataloged components will perform as required, or that they will fit in the allocated physical space for the equipment. It is the Contractor's responsibility to verify that the equipment that is proposed will fit in the allocated physical space and meet all requirements of these Specifications, with all required manufacturers and code required clearances.
  - 2. Equipment submitted for substitution shall meet all Contract Document requirements including quality established by brand specified. Acceptance of submitted material does not grant deviation from Contract requirements. Additional expense resulting by Contractor's decision to use substitute materials must be included in bid sum and shall include all costs by other affected crafts.

3. Material description takes precedence over catalog number listed. Verify with manufacturer correctness of catalog number against material description and accessories.
4. Variations in Equipment: If approved mechanical equipment of another manufacturer requires modification or additions to other work shown on Drawings, arrange for and pay all costs of such changes at no additional cost to Owner.

### **1.03 Submittals**

- A. Procedures: Where a substitution of equipment requires any redesign, prepare all redesign and new Drawings required thereof.
- B. Submittals:
  1. Where an item submitted is designated by number or symbol on Drawings, show this number or symbol.
  2. Check product data for space requirements and conformance with Specification and mark corrections and approval on all product data prior to submittal to Engineer.
  3. Submittals processed by Engineer are not Change Orders.
  4. If deviations, discrepancies or conflicts between Submittals and Specifications are discovered, whether prior to or after Submittals are processed by Engineer, Drawings and Specifications shall control and be followed.
  5. Coordination of mechanical equipment and electrical service to that equipment is solely the responsibility of the Contractor. The Engineer's review of submittals that indicates incorrect electrical service does not relieve the Contractor of the responsibility of providing the correct electrical characteristics at no additional cost to Owner.
  6. Forward a letter listing products and materials proposed for use on this project for products covered in this Section under Part 2 Products, below.
  7. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed and operating), furnished specialties and accessories, and installation and start-up instructions.
  8. Shop Drawings: Submit manufacturer's assembly type shop drawings indicating dimensions, weight loadings, required clearances, methods of assembly of components, location and size of each field connection, arrangement and construction including bussing, and number and type of contactors employed.
  9. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply to equipment. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
  10. Maintenance Data: Submit maintenance data and parts list for equipment including control, accessory, and troubleshooting maintenance guide. Include this data and product data in maintenance manual.
  11. For all equipment that is roof-mounted, floor-mounted, or hung from structure, equipment manufacturer to provide, as a shop drawing submittal, all details, devices, etc., required for appropriate equipment mounting. All details and Drawings to be stamped by a registered structural engineer in the state of California.

## **PART 2 - PRODUCTS**

### **2.01 Asbestos**

- A. Do not use products containing asbestos.

### **2.02 Materials**

- A. Base the contract upon furnishing all materials as specified. All HVAC materials and equipment used for construction shall be new and the latest products as listed in printed catalog data and shall be UL or AGA approved or acceptable by state, county, and city authorities. Equipment supplier is responsible for obtaining state, county, and city acceptance on equipment not UL approved.
- B. All articles fixtures and equipment of a kind shall be the standard product of one manufacturer.
- C. Trade names and manufacturer's names denote the character and quality of equipment desired and shall not be construed as limiting competition.
- D. All materials shall be under warranty for 100% replacement for a period of two (2) years minimum.

## **PART 3 - EXECUTION**

### **3.01 Mutilation**

- A. Repair all mutilation of the existing facilities around pipes, ducts, fixtures, etc.

### **3.02 Equipment Selection and Serviceability**

- A. Locate and install equipment so that it may be serviced. Demonstrate that there is room to remove all pumps and motors, electrical equipment, and similar items.
- B. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to the Owner.
- C. Where piping or control diagrams or sequencing differ from the recommended piping arrangement of the equipment manufacturer, and will directly affect the equipment performance, submit the manufacturer's recommendations in writing to the Engineer for approval, prior to purchasing the equipment involved. Contractor responsible for obtaining such recommendations from the manufacturers in order to effect correct and satisfactory operation of the equipment at the capacities and temperatures indicated.
- D. It is the Contractor's responsibility to maintain design intent where equipment differs from what is shown in the Contract Documents. Where equipment requires piping arrangement, control diagrams, or sequencing different from that indicated in the Contract Documents, provide electrical motors, wiring, controls, or any other required electrical components at no additional cost to the Owner.
- E. The Contract Documents are based on one manufacturer's equipment. Where Contract Documents indicate equipment characteristics or subcomponents that determine equipment characteristics (i.e., sound power levels, inherent pressure versus flow rate curves, non-overloading flow curves, vibration levels and frequencies, etc.), maintain these intended equipment characteristics in the final installation. The Engineer shall review components and methods prior to their installation.
- F. The components and systems indicated on the Contract Documents provide space noise levels below those maximums listed below. Maintain these intended noise levels in the final installation:

Area  
All Areas

NC Level  
35 or Less

### **3.03 Delivery, Storage, and Handling**

- A. Deliver, store and handle materials and equipment in a manner to prevent damage and deterioration. Store in original container that identifies manufacturer's name, brand and model number. Do not store indoor equipment outdoors unless provided with a waterproof protective cover.
- B. Replacement: In event of damage, immediately make all repairs and replacements necessary.

### **3.04 Demonstration**

- A. Upon completion of work and adjustment of all equipment, test systems to demonstrate to Owner's Representative and Engineer that all equipment furnished and installed or connected under provisions of these Specifications functions mechanically in the manner required.
- B. Manufacturer's Field Services: Furnish services of a qualified person for a period of not less than 1 day, at a time approved by the Owner, to instruct maintenance personnel, correct any defects or deficiencies, and demonstrate to satisfaction of Owner that the entire system is operating in a satisfactory manner and complies with all requirements of any other trades or Contractors that may be required to complete work. Complete instruction and demonstration prior to final job site observations. Submit written verification of compliance from Owner's Representative to Engineer.
- C. Operations and Maintenance Data: At time of system demonstration, deliver to Owner two bound copies (3-ring binder type) of operation and maintenance manuals containing following materials:
  - 1. Catalog description of each item of equipment actually installed on job.
  - 2. Instructions for operation and maintenance of mechanical systems composed of operating instructions, maintenance instructions and manufacturer's literature as follows:
    - 1) Maintenance Schedule Chart: Provide an 8-1/2 by 11 inch typewritten list of each item of installed equipment requiring inspection, lubrication or service, describing and scheduling performance of such maintenance.
    - 2) Manufacturer's Literature: Provide copies of manufacturer's instructions for operation and maintenance of all mechanical equipment, including replacement parts list with name and address of nearest distributor. Mark each copy with equipment identification label as listed in Equipment Schedule on Drawings, i.e., AC-5, EF-10, etc.

### **3.05 Cleaning**

- A. Upon completion of installation, thoroughly clean all exposed portions of equipment, removing all temporary labels and traces of foreign substances. Throughout work, remove all construction debris and surplus materials accumulated by this work.

### **3.06 Installation**

- A. Install in accordance with manufacturer's installation instructions, plumb and level, firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- B. Install equipment as described herein.
- C. Controls: Furnish field installed automatic temperature control requirements as indicated.

- D. Manufacturer's Supervision: Equipment manufacturer shall supervise field assembly (if any) and installation of equipment work, with factory trained technical service representative. Prepare manufacturer's written report of installation and testing, signed by representative.
- E. Start up equipment in accordance with manufacturer's start-up instructions and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
  - 1. Do not place equipment in sustained operation prior to initial balancing of mechanical systems.
  - 2. Furnish sufficient refrigerant and dry nitrogen for pressure testing under manufacturer's supervision.

### **3.07 Firestopping Penetrations Fire-Rated Wall/Floor Assemblies**

- A. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop all voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814.

**\*\*END OF SECTION\*\***

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**SECTION 15055  
PIPING MATERIALS AND METHODS**

**PART 1 - GENERAL**

**1.01 Summary**

A. This section specifies the general requirements for piping materials and components and their installation and testing, and shall be used in conjunction with the Section 15060 – Piping Systems and the Contract Drawings.

**1.02 References**

- A. Contractor shall perform all piping in conformance with the requirements stated herein as well as those listed in the Calaveras County Water District Design and Construction Standards Manual, October 2021 Revision.
- B. This section references the following documents. They are a part of this section insofar as specified and modified herein. In case of conflict between the requirements of this section and the listed documents, the requirements of this section shall prevail.

<b><u>Reference</u></b>	<b><u>Title</u></b>
ANSI A13.1	Scheme for the Identification of Piping Systems
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through 24
ASME B16.47	Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard.
AWWA C207	Standard for Steel Pipe Flanges for Waterworks Services-Size 4 Inches Through 144 Inches.
AWWA C651	Standard for Disinfecting Water Mains
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM F37	Standard Test Methods for Sealability of Gasket Materials

**1.03 Submittals:**

- A. Product Data:
1. Plastic Coding Markers.
  2. Tracer Wire.
  3. Warning Tape.
  4. Link Type Seals.
  5. Flange bolts.
  6. Gaskets.

## 1.04 Diagrammed Pipelines

- A. Various pipelines are shown on the drawings in diagram form. These diagrammed pipelines shall be furnished, fabricated, erected and otherwise installed to lines, elevations, locations and dimensions as shown, specified or required for a complete installation. The Contractor shall verify all dimensions shown on the Plans and shall take such field dimensions as may be necessary to properly install all diagrammed pipelines.
- B. The cost of furnishing, fabricating, locating, erecting and otherwise completely and properly installing all diagrammed pipelines shall be included in the lump sum Contract bid price and no separate payment will be made thereof.

## PART 2 - PRODUCTS

### 2.01 Piping

#### A. Material

- 1. Unless otherwise specified, piping materials, including pipe, gaskets, fittings, connection and joint assemblies, lining and coating, shall be selected from those listed on the Section 15060 - Piping Systems. Piping materials shall conform to detailed specifications for each type of pipe and piping appurtenance specified in Division 15.

#### B. Flange Assemblies

##### 1. Ductile Iron Pipe

- a. Bolts and nuts for ductile iron pipe flanges located indoors, outdoors above ground, or in dry vaults and structures shall be carbon steel, ASTM A 307, Grade B.
- b. Bolts and nuts for ductile iron pipe flanges located indoors, outdoors above ground, or in dry vaults and structures where the pressures exceed 150 pounds per square inch shall be alloy steel, ASTM A 193, Grade B7.
- c. Bolts and nuts for ductile iron pipe flanges submerged in water or wastewater, buried, in wet vaults or structures, adjacent to wet walls, or above open water-containing structures shall be Type 316 stainless steel in accordance with ASTM A 193, Grade B8M for bolts and in accordance with ASTM A 194, Grade 8M for nuts.
- d. Bolts and nuts for ductile iron pipe flanges buried shall be Type 316 stainless steel in accordance with ASTM A 193, Grade B8M for bolts and in accordance with ASTM A 194, Grade 8M for nuts.
- e. Provide a washer for each nut. Washer shall be of the same material as the nut.
- f. Nuts shall be Heavy hex-head, Type 2H.
- g. Cut and finish flange bolts to project a maximum of 1/4 inch beyond outside face of nut after assembly.
- h. Tap holes for cap screws or stud bolts when used.

##### 2. Lubricant for stainless steel bolts and nuts:

- a. Chloride-free.
- b. Manufacturers: One of the following or equal:
  - 1) Huskey FG-1800.

##### 3. Plastic pipe:

- a. Bolts and nuts for flanges on plastic pipe located indoors, outdoors above ground, or in dry vaults and structures shall be carbon steel, in accordance with ASTM A 307, Grade B.
  - b. Bolts and nuts for flanges on plastic pipe submerged in water or wastewater, buried, in wet vaults or structures, adjacent to wet walls, or above open water-containing structures and plastic pipe carrying corrosive chemicals shall be Type 316 stainless steel in accordance with ASTM A 193, Grade B8M for bolts and in accordance with ASTM A 194, Grade 8M for nuts.
  - c. Provide a washer for each nut. Washer shall be of the same material as the nut.
  - d. Nuts shall be Heavy hex-head.
  - e. Cut and finish flange bolts to project a maximum of 1/4 inch beyond outside face of nut after assembly.
  - f. Tap holes for cap screws or stud bolts when used.
4. Steel pipe:
- a. Bolts and nuts for ASME B16.5 Class 150 flanges and AWWA C207 Class D flanges located indoors, outdoors above ground, or in dry vaults and structures shall be carbon steel, ASTM A 307, Grade B.
  - b. Bolts and nuts for ASME B16.5 and B16.47 Class 300 flanges and AWWA C207 Class E and F flanges located indoors, outdoors above ground, or in dry vaults and structures in accordance with ASTM A 193, Grade B7 for bolts and in accordance with ASTM A 194, Grade 7 for nuts.
  - c. Bolts and nuts for flanges submerged in water or wastewater, buried, in wet vaults or structures, adjacent to wet walls, or above open water-containing structures shall be Type 316 stainless steel in accordance with ASTM A 193, Grade B8M for bolts and in accordance with ASTM A 194, Grade 8M for nuts.
  - d. Provide a washer for each nut. Washer shall be of the same material as the nut.
  - e. Nuts shall be Heavy hex-head, Type 2H.
  - f. Cut and finish flange bolts to project a maximum of 1/4 inch beyond outside face of nut after assembly.
  - g. Tap holes for cap screws or stud bolts when used.

#### C. Gaskets

- 1. Gaskets for non-steam cleaned ductile iron and steel piping:
  - a. Suitable for pressures equal to and less than 150 pounds per square inch gauge, temperatures equal to or less than 250 degrees Fahrenheit, and raw sewage service.
  - b. Gasket material:
    - 1) Neoprene elastomer with minimum Shore A hardness value of 70.
    - 2) Reinforcement: Inserted 13-ounce nylon fabric cloth for pipes 20 inch or larger.
    - 3) Thickness: Minimum 3/32-inch thick for less than 10-inch pipe; minimum 1/8 inch thick for 10-inch and larger pipe.
  - c. Manufacturers: One of the following or equal:
    - 1) Pipe less than 20 inches in diameter:
      - a) Garlock, Style 7797.
      - b) John Crane, similar product.

- 2) Pipe 20 inches in diameter and larger:
  - a) Garlock, Style 8798.
  - b) John Crane, similar product.
  - c) Or equal.
2. Gaskets for steam cleaned non glass-lined ductile iron and steel piping:
  - a. Suitable for pressures equal and less than 150pounds per square inch gauge, temperatures equal or less than 360degrees Fahrenheit, and raw sewage service.
  - b. Material:
    - 1) Neoprene elastomer, compressed, non-asbestos fiber reinforcement.
  - c. Manufacturers: One of the following or equal:
    - 1) Garlock, Bluegard 3300
    - 2) John Crane, similar product.
    - 3) Or equal.
3. Gaskets for steam cleaned glass lined ductile iron piping:
  - a. Suitable for pressures equal and less than 150 pounds per square inch gauge, temperatures equal and less than 360degrees Fahrenheit, and sludge service.
  - b. Material:
    - 1) Teflon gasketing with 1/16-inch sheet thickness each side (1/8 inch total sheet thickness), filled with corrugated or perforated Type 316 stainless steel ring and non-asbestos filler material with minimum 5/16-inch overall thickness.
  - c. Manufacturers: One of the following or equal:
    - 1) Garlock, Style HP3561.
    - 2) John Crane, similar product.
    - 3) Or
4. Gaskets for flanged joints in polyvinyl chloride and polyethylene piping:
  - a. Suitable for pressures equal to or less than 150pounds per square inch gauge, with low flange bolt loadings, temperatures equal and less than 120 degrees Fahrenheit, and polymer, chlorine, caustic solutions, and other chemicals, except chemicals which liberate free fluorine including fluorochemicals and gaseous fluorine.
  - b. Material: 0.125-inch thick Viton rubber.
  - c. Manufacturers: One of the following or equal:
    - 1) Garlock.
    - 2) John Crane, similar product.
    - 3) Or equal.
5. Gaskets for flanged joints in low pressure air piping:
  - a. Suitable for pressures equal to or less than 150pounds per square inch gauge, temperatures equal to or less than 300degrees Fahrenheit, and compressed air service.
  - b. Material: EPDM elastomer, 1/8 inch thick, 60 Shore hardness, smooth surface.
  - c. Manufacturers: One of the following or equal:

- 1) Garlock, Style 8314.
  - 2) John Crane, similar product.
  - 3) Or equal.
6. Gaskets for flanged joints in ductile iron or steel water piping:
- a. Suitable for hot or cold water, pressures equal to or less than 150 pounds per square inch gauge, and temperatures equal to or less than 160 degrees Fahrenheit.
  - b. Material:
    - 1) Neoprene elastomer, compressed, with non-asbestos fiber reinforcement.
    - 2) Teflon ring; or Teflon envelope with non-asbestos filler.
  - c. Manufacturers: One of the following or equal:
    - 1) Garlock, Bluegard 3300.
    - 2) John Crane, similar product.
    - 3) Or equal.
7. Provide gaskets suitable for the specific fluids and pressure and temperature conditions.

## **2.02 Pipe Identification**

### **A. Plastic Coding Markers**

1. Plastic markers for coding pipe shall conform to ANSI A13.1 as manufactured by W.H. Brady Company, Seton Name Plate Corporation, or equal.
2. Markers shall be the mechanically-attached type that are easily removable; they shall not be the adhesive applied type.
  - a. Markers shall consist of pressure sensitive legends applied to plastic backing that is strapped or otherwise mechanically attached to the pipe.
  - b. Legend and backing shall be resistant to petroleum based oils and grease and shall meet the criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL-STD-810C.
  - c. Plastic coding markers shall not be the individual letter type but shall be manufactured and applied in one continuous length of plastic.
3. Markers bearing the legends on background colors selected by the Owner's Representative shall be provided in the heights required by ANSI A13.1.
4. Pipe markers shall include unidirectional and bidirectional arrows required by ANSI A13.1.

### **B. Tracer Wire**

1. Tracer wire shall be #12 insulated solid strandcopper wire and included for piping as indicated herein.

### **C. Warning Tape**

1. Warning tape shall be 12 inches wide and included for piping as indicated herein. Warning tape shall be made of inert plastic material suitable for direct burial and capable of stretching to twice its original length.
2. Warning tape shall be blue for potable water, purple for recycled water, and green for all other lines.
3. A warning message shall be printed on the tape.

- a. For Potable Water the message shall read "CAUTION: BURIED WATER PIPE BELOW."
  - b. For Sewer Line the message shall read "CAUTION: BURIED SEWER PIPE BELOW".
  - c. For all other services the message shall read "CAUTION: BURIED PIPE BELOW". Letters shall be with black and the message shall be printed at maximum intervals of 2 feet.
4. The message shall be printed at maximum intervals of 2 feet.

### **2.03 Link Type Seals**

#### **A. Characteristics:**

1. Modular mechanical type, consisting of interlocking neoprene or synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.
2. Assemble links solely with stainless steel bolts and nuts to form a continuous rubber belt around the pipe.
3. Provide a nylon polymer pressure plate with Type 316 stainless steel hardware. Isolate pressure plate from contact with wall sleeve.

#### **B. Manufacturers: One of the following or equal:**

1. Calpico, Incorporated.
2. Pipeline Seal and Insulator, Inc., Link-Seal.

## **PART 3 - EXECUTION**

### **3.01 Installation**

#### **A. General:**

1. Only proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be used.
2. The interior of all pipes shall be cleaned of all foreign matter before installing.
3. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
4. Lay pipe with label facing up.
5. While pipe laying is NOT in progress, the open ends of the installed pipe shall be closed to prevent trench water from entering into the interior of the pipe.
  - a. Adequate backfill shall be deposited on pipe to prevent floating of pipe.
  - b. Any pipe that has floated shall be removed from the trench, cleaned, and re-laid in an acceptable manner.
  - c. The use of burlap, wood, or other similar temporary plugs will not be permitted.
6. Cable, rope, or other devices used for lowering fittings into trench shall be attached around the exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fitting's interior for handling.
7. Piping drawings:
  - a. Except in details, piping is indicated diagrammatically. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings. Sizes and locations are indicated on the Drawings.

- b. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed.
  - 1) Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Times.

8. Piping alternatives:

- a. Provide piping as specified in this Section, unless indicated on the Drawings or specified otherwise.
- b. Alternative pipe ratings:
  - 1) Piping with greater pressure rating than specified may be substituted in lieu of specified piping without changes to the Contract Price.
  - 2) Piping of different material may not be substituted in lieu of specified piping.
- c. Valves in piping sections: Capable of withstanding specified test pressures for piping sections and fabricated with ends to fit piping.
- d. For flanged joints, where 1 of the joining flanges is raised face type, provide a matching raised face type flange for the other joining flange.

9. Unless otherwise indicated on the Drawings, piping at pipe joints, fittings, couplings, and equipment shall be installed without rotation, angular deflection, vertical offset, or horizontal offset.

B. Diagrammed Pipe

- 1. Where such pipelines are shown only in diagram, they shall be arranged clear of other pipelines, equipment and walking areas, and shall be accessible for maintenance.
  - a. Such pipelines shall be fitted and installed in a neat and workmanlike manner in accordance with approved shop drawings.
  - b. An adequate number of unions shall be provided to facilitate dismantling or removal.
- 2. The final locations of appurtenances included as part of diagrammed pipelines shall be shown on the approved shop drawings or as determined in the field by the Owner's Representative.

C. Anchorage

- 1. All bends, plugs, joints, caps and tees in pressure piping systems shall be anchored by means of restrained joints unless otherwise specified or shown.

D. Pipe Flexibility

- 1. Unless otherwise specified or shown, wherever piping 6 inches in diameter and larger passes from concrete to earth, 2 sleeve type flexible pipe couplings or flexible joints shall be provided with the first joint between 2 feet and 3 feet from the face of the structure.
  - a. The spacing between the two couplings shall be between 2 and 3 feet.
  - b. A single sleeve type flexible pipe coupling can be utilized if the concrete wall penetration employs a flexible pipe seal.
  - c. Where required for resistance to pressure, flexible couplings shall be restrained.

E. Vents and Drains

- 1. Manual air vents shall be provided at the high points of each reach of pipeline whether shown or not shown on drawings.
  - a. Manual air vents shall consist of a ¼" bronze cock and short copper tubing return.

- b. Copper tubing shall be routed to the nearest floor.
  - c. Manual air vents in piping systems for fluids containing solids shall be 1-inch non-lubricated eccentric plug valves fitted with quick couplers.
2. Whether shown or not shown on drawings all pipelines shall be provided with a tap or welded nipple and valved drain on the bottom of the pipe.
- a. Drains shall be piped to a sump, gutter, floor drain or other collection point.
  - b. Drain valves shall be 1" gate valves unless shown otherwise.
  - c. When drains cannot be run to collection points, they shall be rerouted to a point of easy access.

## F. Pipe Identification

### 1. Pipe Coding

- a. After application of the specified coating or painting and insulation systems, exposed piping, both interior and exterior, and all piping in ceiling spaces, pipe trenches, pipe chases and valve boxes shall be identified with plastic markers.
- b. Locate pipe markers and color bands wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels and plenums), and exterior nonconcealed locations, in locations as follows:
  - 1) Near each valve and control device.
  - 2) Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
  - 3) Near locations where pipes pass through walls or floors/ceilings, or enter nonaccessible enclosures.
  - 4) At access doors, manholes and similar access points which permit view of concealed piping.
  - 5) Near major equipment items and other points of origination and termination
  - 6) Spaced intermediately at maximum spacing of 20 feet along each piping run, except reduce spacing to 10 feet in congested areas of piping and equipment, i.e., mechanical rooms.

### 2. Warning Tape and Tracer Wire

- a. Warning tape shall be installed 12 inches above all potable water, recycled water, primary influent and foul air pipes. Tape shall be spread flat with message side up before backfilling.
- b. Tracer wire shall be continuous and attached to all potable water and recycled water pipes. Tracer wire through valve boxes shall be placed outside of riser and inside of valve box.
- c. The final locations of hose valves and other such appurtenances included as part of diagrammed pipelines shall be shown on the approved shop drawings or as determined in the field by the Owner's Representative.

## G. Wall and slab penetrations:

- 1. Provide sleeves for piping penetrations through aboveground masonry and concrete walls, floors, ceilings, roofs, unless specified or otherwise indicated on the Drawings.
- 2. When indicated on the Drawings, verify that sleeves are large enough inside diameter to clear piping, and that filler material for spaces between piping and sleeve, and synthetic rubber sealing compound at the end of the sleeves are shown.

3. Sleeves shall be placed not closer than 3 diameters center to center, nor shall they impair the strength of construction.
  4. For piping 1 inch in nominal diameter and larger, provide sleeves with minimum inside diameters of 1 inch plus outside diameter of piping. For piping smaller than 1 inch in nominal diameter, provide sleeve of minimum twice the outside diameter of piping.
    - a. Arrange sleeves and adjacent joints so piping can be pulled out of sleeves and replaced without disturbing the structure.
    - b. Cut ends of sleeves flush with surfaces of concrete, masonry, or plaster.
    - c. Conceal ends of sleeves with escutcheons where piping runs through floors, walls, or ceilings of finished spaces within buildings.
    - d. Seal spaces between pipes and sleeves with link-type seals when not otherwise specified or indicated on the Drawings.
  5. Provide flexibility in piping connecting to structures to accommodate movement due to soil settlement and earthquakes. Provide flexibility using details indicated on the Drawings.
- H. Exposed piping:
1. Install exposed piping in straight runs parallel to the axes of structures, unless otherwise indicated on the Drawings:
    - a. Install piping runs plumb and level, unless otherwise indicated on the Drawings.
      - 1) Slope plumbing drain piping with a minimum of 1/4 inch per foot downward in the direction of flow.
  2. Install exposed piping after installing equipment and after piping and fitting locations have been determined.
  3. Support piping:
    - a. Do not transfer pipe loads and strain to equipment.
  4. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, flanged coupling adapters, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.
  5. Assemble piping without distortion or stresses caused by misalignment:
    - a. Match and properly orient flanges, unions, flexible couplings, and other connections.
    - b. Do not subject piping to bending or other undue stresses when fitting piping.
    - c. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
    - d. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
    - e. Alter piping assembly to fit, when proper fit is not obtained.
    - f. Install eccentric reducers or increasers with the top horizontal for pump suction piping.
- I. Buried piping:
1. Bury piping with minimum 3-foot cover without air traps, unless otherwise indicated on the Drawings.
  2. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench.

- a. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.
3. Laying piping:
- a. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
  - b. Place piping with top or bottom markings with markings in proper position.
  - c. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.
  - d. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
  - e. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.
  - f. Concrete encase all buried pipe installed under concrete slabs or structures.
- J. Venting piping under pressure:
1. Lay piping under pressure flat or at a continuous slope without air traps, unless otherwise indicated on the Drawings.
  2. Install plug valves as air bleeder cocks at high points in piping.
    - a. Provide 1-inch plug valves for water lines, and 2-inch plug valves for sewage and sludge lines, unless otherwise indicated on the Drawings.
  3. Provide additional pipe taps with plug cocks and riser pipes along piping as required for venting during initial filling, disinfecting, and sampling.
  4. Before piping is placed into service, close plug valves and install plugs. Protect plugs and plug valves from corrosion.
- K. Restraining piping:
1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
    - a. When piping is underground, provide full mechanical restraint on new piping and add thrust blocks at all connections to existing piping.
    - b. When piping is aboveground or underwater, use mechanical or structural restraints.
    - c. Determine thrust forces by multiplying the nominal cross sectional area of the piping by design test pressure of the piping.
  2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
    - a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.
  3. Place concrete thrust blocks against undisturbed soil.
  4. Place concrete so piping joints, fittings, and other appurtenances are accessible for assembly and disassembly.
  5. Provide underground mechanical restraints where specified in the Piping Schedule.
- L. Connections to existing piping:

1. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings:
    - a. Protect domestic water/potable water supplies from contamination:
      - 1) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
      - 2) Provide devices approved by Owner of domestic water supply system to prevent flow from other sources into the domestic supply system.
  2. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
  3. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
  4. For flanged connections, provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.
- M. Connections to in-service piping:
1. Shutdown in-service piping in coordination with local utilities:
    - a. Establish procedures and timing in a conference attended by Contractor, Engineer, and District of the in-service piping.
  2. Where operation and maintenance of existing facilities require that a shutdown be made during hours other than normal working hours, perform the related work in coordination with the hours of actual shutdown.
  3. Where shutdown of existing piping is not feasible, perform work by hot tapping or by using a temporary bypass around the work area.
- N. Connections between ferrous and nonferrous metals:
1. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
  2. Nonferrous metals include aluminum, copper, and copper alloys.
- O. Flanged connections between dissimilar metals such as ductile iron pipe and steel pipe:
1. Provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

### **3.02 Cleaning and Flushing**

#### **A. General:**

1. Piping systems shall be flushed and cleaned prior to testing. The Contractor may, in order to facilitate the cleaning of sections of buried or exposed piping between isolating valves, clean and test the system as specified in this section, prior to connection to the valving. Use of this procedure, however, will not waive the requirement for a full test of the completed system.
2. Unless specified otherwise, piping 24 inches in diameter and smaller shall first be cleaned by pulling a tightly fitting cleaning ball or swab through the system.
3. Piping larger than 24 inches in diameter may be cleaned manually or with a cleaning ball or swab.

#### **B. Cleaning Potable Water Piping:**

1. Flush and disinfect potable water piping as specified in Section 01757.

#### **C. Air Systems:**

1. Air or Foul Air system piping 6 inches in diameter and smaller shall be blown out, using air or the testing medium specified.
2. Air or Foul Air system piping larger than 6 inches shall be cleaned by having a swab or “pig” drawn through the entire length of the pipe. After connection to the equipment, it shall then be blown out using the equipment.

D. Cleaning Filtration System Piping:

1. Thoroughly clean all Filtration System process piping by flushing with water.
  - a. Conduct cleaning operation after piping connections are completed and after piping has successfully passed pressure test.
2. Utilize potable quality water, softened to remove hardness, for flushing water.
  - a. Utilize the manufacturer’s cleaning recommendations for type and quantity of water.
3. Flush piping with water in sufficient quantities to produce a flow velocity of 6 feet per second in the main pipe and branch lines.
4. Continue flushing until at least twice the volume of pipe has been flushed.
5. Disconnect instruments and piping less than 1/2 inch in nominal diameter prior to flushing operation.
  - a. After flushing operation is completed, drain entire system, and reconnect piping and steam traps.
6. When cleaning operation is complete, remove temporary piping, pumps, and tanks, used to accomplish pipe cleaning.
7. Prior to beginning cleaning operation, submit plan for the cleaning operation. Include details of equipment, and procedures for review and approval.

E. Liquid Systems:

1. After completion of cleaning, piping systems 12” and less shall be flushed with clean water for a minimum period of 15 minutes at the flow rate required to produce a minimum velocity of 6 feet per second.
  - a. Contractor is responsible for all temporary piping and facilities required.
  - b. Contractor shall comply with all State and Local regulations and requirements for disposal of flushing water.
2. Potable water piping systems shall be flushed and disinfected in accordance with AWWA C651. Post disinfection testing shall be done and paid for by the Contractor.

### 3.03 Testing

A. Upon completion of installation the Contractor shall test each piping system.

1. Pressures, media and test durations shall be as specified in the Section 15060.
2. Equipment that may be damaged by the specified test conditions shall be isolated.
3. Each test gauge shall be selected so that the specified test pressure falls within the upper half of the gauge’s range.
4. The Contractor shall notify the District’s Representative prior to each test and shall perform each test in the presence of the District’s Representative.
5. Pipes shall not be encased in concrete until leakage test is completed and passed.

6. Pipes shall not be covered by concrete slabs or pavement until leakage test is completed and passed.
7. Exposed Pipes shall not be insulated until leakage test is completed and passed.
8. Flanges or flex couplings shall not be backfilled or buried until leakage test is completed and passed.

B. Pumped or Pressure Systems:

1. Prior to testing, the pipeline shall be slowly and carefully filled with water. All air shall be expelled slowly from the pipe and appurtenances in a manner so as not to create excessive surge pressures.
2. The pipeline shall be filled with water at least twenty-four hours prior to testing when.
3. Where air valves or other suitable outlets are not available for releasing air before applying the test, approved taps and fittings shall be installed and later securely plugged.
4. The Contractor may, at his own risk, test against existing valves. Suspected leaking of the existing valves will not be accepted as a reason for having not passed the leakage test requirements. These valves shall either be repaired or replaced prior to the start of another testing sequence. All new valves shall be tested against a reduced pressure side. Butterfly valves shall be tested in both directions.
5. The length of pipe being tested at any one time shall not exceed 2,000 feet unless otherwise approved by the District.
6. The pipeline then shall be brought up to 200 psi or 50 psi greater than design pressure of the system, whichever is greater, measured at the lowest point of the section of the pressure zone being tested.
7. The test duration shall be two hours. Pressure in the pipeline shall be maintained within 2 psi of the calculated test pressure for the full two-hour duration. The individual testing of the valves may be of a shorter duration as approved by the District.
8. The allowable leakage per test section shall be calculated from the formula below:
  - a.  $W = N \cdot D \cdot (P^{0.5} / 7400)$  where
    - 1)  $W$  = allowable leakage in gal/hr
    - 2)  $N$  = number of joints in the length of pipeline tested
    - 3)  $D$  = normal diameter in inches
    - 4)  $P$  = Average test pressure in psi
9. During the pressure and leakage test, all accessible appurtenances shall be inspected for visual signs of leakage.
10. All visible leaks shall be corrected immediately, regardless of the amount of leakage and the test shall be run again for its full duration.
11. All leaks detected shall be repaired to a water tight condition.

C. Gravity Systems

1. Mandrel Test
  - a. The test shall be performed after backfill and compaction but prior to final paving and prior to leak testing.
  - b. The pipeline shall be balled and flushed just prior to pulling the mandrel through.

- c. A rigid mandrel with a circular cross section of 95% of true average inside diameter shall be pulled through by hand.
- d. If the mandrel sticks in the pipe at any point, the pipe shall be repaired or replaced and retested.

2. Air Test

- a. After the mandrel test, each section of the gravity pipeline between successive manholes/structures shall be air tested as follows:
  - 1) With all outlets plugged, air shall be slowly added until the internal pressure is raised to 4.0 pounds per square inch gage (psig).
  - 2) The air compressor used to add air to the pipeline shall have a blowoff valve set at 5 psig to ensure that at no time the internal pressure in the pipeline exceeds 5 psig.
  - 3) The internal pressure of 4 psig shall be maintained for at least two minutes to allow the air temperature to stabilize, after which the air supply shall be disconnected and the pressure allowed to decrease to 3.5 psig.
  - 4) The time in minutes that is required for the internal air pressure to drop from 3.5 psig to 3.0 psig shall be measured. The results shall not be less than the minimum permissible duration for the air test pressure drop shown in the table below.

<b>Pipe Size (inches)</b>	<b>Minimum Time (seconds)</b>
6 and smaller	170
8	230
10	300
12 and larger	430

D. Air Systems

- 1. Air piping pressure test using water:
  - a. Shall be tested by bringing the section being tested to the test pressure for the duration specified.
  - b. Leakage shall be zero for the duration specified.
- 2. Air piping pressure test using air:
  - a. Pressure test the section to 3.5 psi and hold above 3.0 psi for not less than 5 minutes. Add air necessary to keep the pressure above 3.0 psi. At the end of this 5 minute saturation period, note the pressure (must be above 3.0 psi) and begin the time period. If the pressure drops 0.5 psi in less than the time given in the following table the section of pipe shall not have passed the test.

<b>Pipe Size (inches)</b>	<b>Minimum Time (seconds)</b>
4	122
6	184
8	245
10	306
12	367
15	460
>15	370 x pipe diameter in feet

**\*\*END OF SECTION\*\***

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## SECTION 15060 PIPING SYSTEMS

### PART 1 - GENERAL

#### 1.01 Summary

- A. This Section specifies requirements for piping systems consisting of pipe, fittings and valves.
- B. Specific requirements for piping and valves included within each piping system are specified on individual pipe and valve specifications.

#### 1.02 References

- A. This Section references the following documents. They are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI B16.3	Malleable-Iron Threaded Fittings
ANSI B16.9	Factory-Made Wrought Steel Butt-Welding Fittings
ASTM A47	Malleable Iron Castings
ASTM A53	Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
ASTM A120	Pipe, Steel, Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless for Ordinary Uses
ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A312	Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A403	Wrought Austenitic Stainless Steel Pipe Fittings
ASTM D1784	Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
ASTM D1785	Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
ASTM D2751	Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
ASTM D2466	Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
ASTM D2467	Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
ASTM D2564	Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
ASTM F439	Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
ASTM F441	Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic

<b><u>Reference</u></b>	<b><u>Title</u></b>
	Pipe, Schedules 40 and 80.
ASTM F493	Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
AWWA C106	Standard for Gray-Iron Pipe Centrifugally Cast in Metal Molds for Water or Other Liquids
AWWA C108	Standard for Cast-Iron Pipe Centrifugally Cast in Sand-Lined Molds for Water or Other Liquids
AWWA C110	Gray-Iron and Ductile Iron Fittings 3 Inch Through 48 Inch for Water and Other Liquids
AWWA C111	Standard for Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C151	Standard for Ductile Iron Pipe Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids
AWWA C200	Steel Water Pipe 6 Inches and Larger
AWWA C205	Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe 4 Inches and Larger - Shop Applied.
AWWA C208	Standard Dimensions for Steel Water Pipe
AWWA C210	Standard for Coal-Tar Epoxy Coating System for the Interior and Exterior of Steel Water Pipe
AWWA C900	Standard for PVC Pressure Pipe

### 1.03 Piping System Specification Sheets (Pipespec)

- A. Each process piping system is specified in the following PIPESPEC sheets:
- B. Piping services are grouped according to the chemical and physical properties of the fluid conveyed and/or by the temperature or pressure requirements. Each grouping of services is identified by a piping system number.
- C. The following list the piping services and associated system number, fluid category, and pipe marker background color of each service.

<b>Service Abbreviation</b>	<b>Service</b>	<b>System</b>	<b>Category</b>	<b>Color</b>
CL	Chlorine Line	10	Chemical Distribution	None
DSL	Digested Sludge	5	Process	Brown
DSN	Digested Supernatant	5	Process	Brown
FE	Filtered Effluent	5	Process	Brown
ML	Mixed Liquor	5	Process	Brown
RAS	Recycled Activated Sludge	5	Process	Brown

<b>Service Abbreviation</b>	<b>Service</b>	<b>System</b>	<b>Category</b>	<b>Color</b>
SCM	Clarifier Scum Discharge	5	Process	Brown
SD	Storm Drain	11	Wastewater	None
SE	Secondary Effluent	5	Process	Brown
WAS	Waste Activated Sludge	5	Process	Brown
BA	Blower Aeration	14	Air	None

## PART 2 - MATERIALS

### 2.01 Piping Materials

#### PIPING SYSTEM SPECIFICATION SHEET: SYSTEM 5

System Includes: DSL – Digested Sludge  
DSN – Digested Supernatant  
FE – Filtered Effluent  
ML – Mixed Liquor  
RAS – Recycled Activated Sludge  
SCM – Clarifier Scum Discharge  
SE – Secondary Effluent  
WAS – Waste Activated Sludge

#### Test Requirements

Medium: Water  
Pressure: 50 psi for non-pumped pipes and 150 psi for pressured pipes  
Duration: 120 Minutes with no detectable leakage

#### Gasket Requirements

Flange/ Cpl Neoprene (Oil resistant)

#### Exposed/Valve Vault Piping (3-inch and smaller)

Pipe: Galvanized steel, ASTM A53  
Pressure Class/Thickness: Schedule 40  
Joints: Flanged or threaded, as shown on the Plans, ASTM A243, ANSI B16.11  
Fittings: Flanged or threaded, as shown on the Plans, ASTM A243, ANSI B16.11  
Valves: Ball, hose valves, as shown on the Plans  
Insulation: Glass Fiber, ASTM C547; rigid molded, noncombustible.  
Thermal Conductivity Value: 0.27 at 75 deg. F.  
Maximum Service Temperature: 850 deg. F.  
Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples or vapor barrier mastic as needed. Insulation Thickness: 1-1/2"

#### Exposed/Valve Vault Piping (4-inch and larger)

Pipe: Ductile iron, AWWA C151, epoxy/polyurethane coating system, ceramic epoxy lining system

Pressure Class/Thickness: Class 350

Joints: Flanged or Grooved, as shown on the Plans, fully restrained

Fittings: Ductile iron, AWWA C110 or C153, thickness, lining, and coating to match pipe or FBE lining and coating, Grooved or Flanged as shown

Valves: Plug, Butterfly, Gate, Check Valves, as shown on the Plans

Insulation: Glass Fiber, ASTM C547; rigid molded, noncombustible.  
Thermal Conductivity Value: 0.27 at 75 deg. F.  
Maximum Service Temperature: 850 deg. F.  
Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples or vapor barrier mastic as needed. Insulation Thickness: 1-1/2"

Buried Piping

**(4-inch and larger)**

Pipe: Polyvinyl chloride (PVC), AWWA C900C/905  
or  
Ductile iron, AWWA C151 class 350, ceramic epoxy lining system or fusion bonded epoxy and fusion bonded epoxy coating and polyethylene encasement.

Pressure Class/Thickness: Class 235/ DR-18 (PVC) or Class 350

Joints: Mechanical, fully restrained as shown on the Plans

Fittings: Ductile Iron, AWWA C110 or C153, class 350, ceramic epoxy lining system or fusion bonded epoxy lining and fusion bonded epoxy coating and polyethylene encasement.

Valves: Gate or Plug

Buried Piping

**(3-inch and smaller)**

Pipe: PVC SCH 80, normal impact, solvent welded joints.

Fittings: PVC SCH 80, normal impact.

Valves: Gate

Intermittently Submerged and Submerged Piping **(All sizes)**

Pipe: Steel epoxy coated and lined as indicated on Drawings, Schedule 40S, Type 316

Joints: Welded or Flanged. See Plans. Use insulated flange kit for connection to ductile iron piping.

Fittings: Welded or flanged where shown.

Valves: None

## PIPING SYSTEM SPECIFICATION SHEET: SYSTEM 10

System Includes: CL – Chlorine Line

Test Medium: Water

Test Pressure: 80 psi

Test Duration: 120 Minutes with no detectable leakage

Flange Gaskets: N/A

Mechanical Joint/Coupling Gaskets: N/A

### Exposed Piping (2½-inch and smaller)

Pipe: PVC SCH 80, normal impact, solvent welded joints.

Fittings: PVC SCH 80, normal impact.

Valves: True Union PVC Ball

### Buried Piping (3-inch and smaller)

Pipe: PVC SCH 80, normal impact, solvent welded joints.

Fittings: PVC SCH 80, normal impact.

Valves: True Union PVC Ball

## PIPING SYSTEM SPECIFICATION SHEET: SYSTEM 11

System Includes: SD – Storm Drain

### Test Requirements

Medium: Air  
Pressure: Low Air Pressure Test Per Manufacturer  
Duration: As required by the manufacturer

### Gasket Requirements

Flange/ Cpl Neoprene (oil resistant)

### Exposed Piping (4-inch and larger)

#### All Sizes

Pipe: Polyvinyl chloride (PVC), ASTM D1785, schedule 80, coating per Section 09900 – Coating Systems, see Section 15064 – PVC Pipe.  
Joints: Solvent welded socket or Flanged  
Fittings: Polyvinyl chloride (PVC), schedule 80, Solvent welded socket  
Valves: Ball

### Buried Piping (4-inch and larger)

Pipe: Reinforced Concrete Pipe, Class III ASTM C-76 & AASHTO M-170. Portland Cement per ASTM-C150  
Joints: Push on, Bell and Spigot Joints ASTM C-443 w/ ASTM C-361 Gaskets  
Fittings: As required per Plan.  
Valves: None

## PIPING SYSTEM SPECIFICATION SCHEDULE – SYSTEM 14

System Includes: **BLOWER AIR (BA)**  
Test Medium: Air  
Test Pressure: 15 psi  
Test Duration: 120 Minutes with no detectable leakage  
Flange Gaskets: Silicone rubber  
Mechanical Joint/Coupling Gaskets: Silicone rubber

General Note: Carbon steel piping is only allowed at points of connection with existing carbon steel pipes. Stainless Steel to be used at all other locations as shown in Contract Drawings.

### Exposed Piping (All Sizes)

Pipe: Stainless steel, Schedule 40S, Type 316.  
Joints: Welded or Flanged.  
Insulation: All exposed pipes shall have a thermal insulation, assuming highest operation temperature 350°F.  
Fittings: Stainless steel, Type 316, thickness to match pipe, flanged.  
Expansion Coupling: Flanged 316 Stainless Steel Expansion Coupling, installed with flange isolation kits rated for 350°F min.  
Valves: Ball

### Buried Piping (All sizes)

Pipe: Steel, ASTM A53, Type E, Grade B, Schedule 40 Hot Dip Galvanized. UL Listed and FM Approved. Pipe shall be domestically manufactured in the United States by Wheatland Tube or approved equal.  
Coating: Poly encasement  
Fittings: Welded joints, flanged where shown. Welded fittings to be standard weight (Schedule 40) conform with ASTM A234 WPB, A53, and ANSI B16.9 and B16.28. Joints shall be shop welded except where field joints are approved by Engineer to facilitate final assembly. Fittings shall be domestically manufactured in the United States by Weldbend or approved equal.  
Valves: None

### Buried Piping (All sizes)

Pipe: Stainless steel, Schedule 40S, Type 316.

Joints: Welded or Flanged. See Plans. Use insulated flange kit for connection to carbon steel piping.

Fittings: Stainless steel, Type 316, thickness to match pipe, flanged.

Valves: None

Submerged Piping    **(All sizes)**

Pipe: Stainless steel, Schedule 40S, Type 316

Joints: Welded or Flanged.

Fittings: Stainless steel, Type 316, thickness to match pipe, female threaded to connect to threaded disc diffusers.

Valves: None

High Capacity Fine Bubble Disc Diffusers

**(12 inch)**

Material: Glass-filled polypropylene body with EPDM membrane suitable for continuous submergence in wastewater digested sludge service. Perforation size and number of diffusers shall be determined by the Vendor.

Diffusers Designed Airflow: continuous 13 cfm max per diffuser  
Intermittent 18 cfm max per diffuser

Connection: ¾" NPT male thread

Manufacturer: EDI, OTT, DDI SuperFlex or equivalent, approved by Engineer

Service Life: Min 5 years

**PART 3 - EXECUTION (NOT USED)**

**\*\* END OF SECTION\*\***

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# SECTION 15061 STEEL PIPE

## PART 1 - GENERAL

### 1.01 Summary

A. This section specifies steel pipe, fittings, connections, linings, and coatings for water and air service applications.

### 1.02 References

A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
AWWA C200	Standard for Steel Water Pipe
AWWA C203	Standard for Coal-Tar Protective Coatings and Linings for Steel water Pipeline - Enamel and Tape - Hot Applied.
AWWA M11	Steel Pipe – A Guide for Design and Installation
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe – Shop Applied
AWWA C206	Standard for Field Welding of Steel Water Pipe
AWWA C207	Standard for Steel Pipe Flanges for Waterworks Service
AWWA C208	Standard for Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings
AWWA C602	Standard for Cement-Mortar Lining of Water Pipelines – In Place
AWWA C604	Installation of Buried Steel Water Pipe
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
ASTM A234	Standard Specification for Steel Pipe Fittings
PCWA	Placer County Water Agency Standard Specifications (2017)
AWS D1.1	Structural Welding Code - Steel
AWS A3.0	Standard Welding Terms and Definitions
AWS QC1	Standard for AWS Certification for Welding Inspectors
SPFA	Steel Pipe Fabricators Association Quality Certification Program for Steel Pipe and Accessory Manufacturers

### 1.03 Submittals

A. Descriptive literature showing pipe dimensions, joints, couplings, coatings/linings and other details for each size of pipe indicated.

- B. Affidavits of Compliance with AWWA C200, AWWA C205, AWWA C209, AWWA C213, AWWA C214, ASTM A53, and ASTM A106, as applicable, and Contractor's layout drawings shall be submitted in accordance with Section 01330 – Submittals.
- C. Fabrication drawings.
- D. Factory test reports.
- E. Coating manufacturer's qualifications.
- F. Reports of ASME Section IX welding certifications.

#### **1.04 Quality Assurance**

##### **A. Manufacturer Qualifications**

1. Pipe fabrication process at the plant facility shall have current SPFA and ISO 9001 Certification.
2. The pipe manufacturer shall have a minimum of five (5) years continuous experience in manufacturing the pipe and fittings specified for this project
3. Qualifying experience for pipe and fittings fabrication shall include a minimum of three projects completed or in current fabrication within the past five (5) years with similar diameters and wall thickness.

##### **B. Welder Qualifications**

1. Qualify and certify welding procedures, welders, and operators in accordance with ASME Section IX, for shop welding and AWS D1.1 for project site welding of piping work.
2. Qualification for welders: Welding shall be performed by welders holding current certification for the welding procedures in use.

##### **C. Tests**

1. All materials used in the manufacture of the pipe shall be tested in conformance with AWWA C200 and C205.

#### **1.05 Delivery, Storage, and Handling**

- A. During loading, transportation and unloading, prevent damage to pipes and coatings. Load and unload each pipe under control at all times. Under no circumstances will a dropped pipe be used unless inspected and accepted by the Owner's Representative. Place skids or blocks under each pipe in the shop and securely wedge pipe during transportation to protect pipe, lining, and coating.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Jifco, Inc./Livermore, CA
- B. Ameron
- C. Northwest Pipe
- D. Hanson
- E. Mid America
- F. Weathland Tube

G. Or Equal

## 2.02 Pipe

- A. ASTM A53 and A106: The minimum wall thickness for ASTM A53 and ASTM A106 pipe shall be Schedule 40 for pipe 10-inch diameter and less and 3/8 inch for pipe 12-inch through 24-inch diameter. Increased shell thickness shall be provided where specified.

## 2.03 Fittings and Appurtenances

- A. Malleable iron threaded fittings and appurtenances shall conform to the requirements of ASTM A47 or ASTM A197, ANSI B16.3.
- B. Steel fittings and appurtenances shall conform to the requirements of ASTM A234 or ASTM A105, ANSI B16.11.
- C. Fabricated steel fittings and appurtenances shall conform to AWWA C200 and C208. All fittings shall be designed in accordance with AWWA Manual M11 for the design pressures of the external loads shown
- D. Wall thickness for fittings shall be reinforced to withstand either internal pressures, both circumferential and longitudinal, or external loading conditions, whichever is greater. In no case shall wall thickness of fittings be less than that of adjacent pipe.

## 2.04 Connections

### A. Threaded Connections:

1. Pipe thread dimensions and size limits shall conform to ANSI B1.20.1.

### B. Welded Joints:

1. Provide field welds, in accordance with AWWA C206. See plans for connection details.
2. Welded connections shall be sound and free from embedded scale or slag, with tensile strength of weld not less than that of thinner of connected sections. Welds to be watertight.
3. Field Welds of buried piping shall be one of the following:
  - a. Bell and spigot lap welds
    - 1) Shall be double weld (inside and outside).
    - 2) Provide ¼" NPT air test holes with lining blockouts.
  - b. Butt strap welds
    - 1) Shall be welded both inside and outside joint.
    - 2) Longitudinal joint in the butt-strap to use full-penetration welds before making the circumferential fillet welds.
    - 3) Provide ¼" NPT air test holes with lining blockouts.
    - 4) Do not make alignment changes at butt-strap joints
    - 5) Do not use mitered Butt-straps

### C. Flange Connections:

1. Flanges: Unless otherwise specified, steel flanges shall be Class D, E or F ring flanges for internal pressures up to 150 psi, 275 psi, and 300 psi, respectively in accordance with AWWA C207. Flanges shall be in conformance with ASME B16.447 for higher pressure applications.
2. All Bolts and nuts shall be type 316 stainless steel per ASTM F593 and F594.

3. Use flat faced flanges to mate with dissimilar materials.
  4. Blind flanges shall be in accordance with the appropriate standard as determined by the maximum operating pressure.
- D. Gaskets shall be as shown in Section 15060.
- E. Bolts: Flange assembly bolts shall be SAE Grade 5, ANSI B18.2.1 hexagon head carbon steel machine bolts with ANSI B18.2.2 hot pressed heavy hexagon nuts. Threads shall be ANSI B1.1, standard coarse thread series; bolts shall be Class 2A, nuts shall be Class 2B. Bolt length shall conform to ANSI B16.5. Flange assembly bolts and nuts for submerged or buried service shall be type 316 stainless steel regardless of any other protective coating.
- F. Insulating Flange Joints: Insulating flange joints shall have 1/6-inch thick plastic, full length bolt sleeves, with 1/8-inch thick insulating washers and flat washer for each flange bolt.

## **2.05 Pipe Lining**

### **A. Cement Mortar Lining:**

1. Where specified, pipe (including butt ends) and fittings shall be lined with cement mortar as specified in AWWA C205. Fittings and specials larger than 24 inches, not fabricated from centrifugally lined straight sections, shall require 2 inch by 4 inch by 13 gage self furring wire mesh reinforcement for hand-applied lining.
2. Fly ash or pozzolan shall not be used as a cement replacement
3. Cement mortar lining cracks shall be classified and repaired in conformance with AWWA C205
4. Taper cement mortar lining as required for valve interfacing.

### **B. Fusion Epoxy Lining:**

1. Where specified, pipe (including butt ends) and fittings shall be fusion bonded epoxy coated and lined in accordance with AWWA C213. Surface preparation shall be in accordance with SSPC-SP 10/NACE No. 2 Near White Blast Cleaning. The application method shall be by the fluidized bed method and shall attain 12 mils minimum dry film thickness.
2. Fusion bonded epoxy coating and lining shall be 3M Scotchkote 206N, or equal.
3. Coatings and linings at field grooving, if allowed by the Engineer, shall be patched according to the coating manufacturer's instruction with 3M Scotchkote 206N.
4. Damaged areas shall be patched according to the coating manufacturer's instructions with 3M Scotchkote 206N.

## **2.06 Pipe Coating**

### **A. Cement Mortar Coating:**

1. Where specified, pipe and fittings shall be coated with cement mortar in accordance with AWWA C205 except the coating thickness shall be 3/4-inch, minimum.
2. Fly ash or pozzolan shall not be used as a cement replacement
3. Cement mortar lining cracks shall be classified and repaired in conformance with AWWA C205.
4. Flanges and portions of pipe and fittings not covered with cement mortar shall be shop primed.

### **B. Fusion Epoxy Coating:**

1. Where specified, pipe and fittings shall be fusion epoxy coated in accordance with AWWA C213. Surface preparation shall be in accordance with SSPC-SP 10 Near White Blast Cleaning. The application method shall be by the fluidized bed method and shall attain 12 mils minimum dry film thickness.
  2. Field welds, connections and otherwise damaged areas shall be coated and patched according to the manufacturer's instructions with 3M Scotchkote 206N.
  3. Fusion epoxy coating shall be 3M Scotchkote 203, or equal.
- C. Polyethylene Tape Coating:
1. Where specified, pipe and fittings shall be coated with primer and wrapped in accordance with AWWA C214 and C209. The coating application shall be a continuous step operation in conformance with AWWA C214, Section 3. The total coating thickness shall be not less than 50 mils for pipe 24 inches and smaller and not less than 80 mils for pipe 26 inches and larger.
  2. Polyethylene tape coating system shall be as specified in AWWA C214 and C209.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Installed work in accordance with AWWA M11, AWWA C604, and per contract documents.
- B. Joining Methods - Flanges:
1. Facing method:
    - a. Insert slip-on flange on pipe.
    - b. Assure maximum tolerances for flange faces from normal with respect to axis of pipe is 0.005 IN per foot of flange diameter.
    - c. Test flanges after welding to pipe for true to face condition and reface, if necessary, to bring to specified tolerance.
- C. Joining Method - Welded Joints:
1. Perform welding in accordance with AWWA C206 and this Section.
  2. For flange attachment perform in accordance with AWWA C207.
  3. Have each welding operator affix an assigned symbol to all his welds.
  4. Mark each longitudinal joint at the extent of each operator's welding.
  5. Mark each circumferential joint, nozzle, or other weld into places 180 degrees apart.
  6. Joining method:
    - a. Leave 1/8 to 3/8 IN of flange bolts projecting beyond face of nut after tightening.
    - b. Coordinate dimensions and drillings of flanges with flanges for valves, pumps, equipment, tank, and other interconnecting piping systems.
    - c. When bolting flange joints, exercise extreme care to assure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or cause unnecessary stress, bending or torsional strains being applied to cast flanges or flanged fittings.
      - 1) Allow one (1) flange free movement in any direction while bolts are being tightened.

- d. Do not assemble adjoining flexible coupled, mechanical coupled or welded joints until flanged joints in piping system have been tightened.
- e. Gradually tighten flange bolts uniformly to permit even gasket compression.
- f. Do not overstress bolts to compensate for poor installation.

D. Install buried piping per Section 15060.

### **3.02 Testing**

A. Hydrostatic testing shall be per Section 15060 in accordance with Section 4 of AWWA C600.

**\*\*END OF SECTION\*\***

## SECTION 15062 DUCTILE IRON PIPE

### PART 1 - GENERAL

#### 1.01 Summary

A. This section specifies ductile iron pipe, ductile or gray iron fittings and gaskets.

#### 1.02 References

A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI/ASME B1.20.1	Pipe Threads General Purpose
ANSI/ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ANSI/ASME B16.5	Pipe Flanges and Flanged Fittings
ANSI/ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI/ASME B18.2.2	Square and Hex Nuts (Inch Series)
ANSI/ASME B31.1	Power Piping; Includes Addenda (2005) and Addenda (2006)
ANSI/ASME B31.8	Gas Transmission and Distribution Piping Systems
ANSI/AWWA C104/A21.4	Cement Mortar Lining for Ductile Iron Pipe and Fittings
ANSI/AWWA C105/A21.5	Polyethylene Encasement for Ductile Iron Pipe Systems
ANSI/AWWA C110/A21.10	Ductile Iron and Gray Iron Fittings (3-in through 48-in)
ANSI/AWWA C111/A21.11	Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings
ANSI/AWWA C115/A21.15	Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges
ANSI/AWWA C116/A21.16	Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings
ANSI/AWWA C150/A21.50	Thickness Design of Ductile Iron Pipe
ANSI/AWWA C151/A21.51	Ductile Iron Pipe, Centrifugally Cast, for Water (3-in through 64-in)
ANSI/AWWA C153/A21.53	Ductile Iron Compact Fittings for Water Service

<b><u>Reference</u></b>	<b><u>Title</u></b>
ANSI/AWWA C600	Installation of Ductile Iron Water Mains and their Appurtenances
ANSI/AWWA C606	Grooved and Shouldered Joints
ANSI B18.2.1	Square and Hex Bolts and Screws
ASTM A377	Index of Specifications for Ductile Iron Pressure Pipe
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A674	Standard Practice for Polyethylene Encasement for Ductile Iron Piping for Water or Other Liquids
ASTM A716	Pipe Specification for Ductile Iron Culvert Pipe
ASTM A746	Standard Specifications for Ductile Iron Gravity Sewer Pipe

### **1.03 Definitions**

A. Where cast iron pipe is specified, the term and symbol shall mean ductile iron pipe.

### **1.04 Submittals**

A. The Contractor shall submit the following in accordance with Section 01330 – Submittals:

1. Shop drawings
2. Alignment/ layout drawings
3. Certification that such length of pipe has been tested physically for ductility and has satisfactorily passed such tests.
4. Manufacturers' Affidavits of compliance with applicable references.
5. Manufacturer's product data to include size, type, weight, gasket materials, materials standards and installation requirements for pipe, connections and fittings.

### **1.05 Quality Assurance**

A. Testing

1. Factory testing shall conform to the requirements of all applicable references.

## **PART 2 - PRODUCTS**

### **2.01 Pipe**

A. Pipe design, materials, and manufacture shall comply with the latest revision of the following documents:

Item	Document
Thickness Design	ANSI/AWWA C150/A21.50
Pressure Pipe (Water and Other Liquids)	ANSI/AWWA C151/A21.51
Pressure Pipe (Gas)	ANSI/ASME B31.8
Non-Pressure Pipe (Sewer)	ASTM A746
Non-Pressure Pipe (Other Liquids)	ANSI/AWWA C151/A21.51
Non-Pressure Pipe (Culvert)	ASTM A716
Threaded Flange	ANSI/AWWA C115/A21.15
Fittings	ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53
Rubber Gaskets <sup>1</sup>	ANSI/AWWA C111/A21.11
Polyethylene Encasement (Water)	ANSI/AWWA C105/A21.5
Polyethylene Encasement (Other Liquids)	ASTM A674

<sup>1</sup> Manufactured in accordance with the applicable requirements of the AWWA standard, material specified below

## 2.02 Connections and Fittings

### A. Connections

#### 1. Joints

##### a. Push-on and Mechanical:

- 1) The plain ends of push-on pipe and mechanical joint pipe shall be marked with paint to show the required depth of penetration for making the joint.
- 2) All fittings to be mechanical joint or flanged for buried services and flanged for all exposed services, except where otherwise shown or call out on the plans.

##### b. Mechanically Restrained:

- 1) Mechanically restrained joints shall be designed to prevent separation of the joint by the pipe's internal thrust after installation.
- 2) The design shall permit disassembling of the joint for repair and maintenance.
- 3) Restraints shall be Field Lok 350 Gaskets (4 – 24 inch diameter), TR Flex, Fast-Grip Gaskets (4-24 inch), Megalug 1100 Series (3-48 inch), Megalug Series 1700, or approved equal.
- 4) Restraint gland bodies to have heat cured polyester powder coat and wedges coated with thermoset epoxy.

#### 2. Flange Assemblies

- a. Flange assemblies shall be provided as specified in Section 15055 - 2.01 and herein.
- b. Flanges shall be faced in accordance with ANSI B16.1

#### 3. Grooved End Couplings:

- a. Where shown on the Drawings, grooved end couplings shall be
  - 1) Victaulic Style 31, Star Pipe AC-9 or equal.
- 4. Sleeve-Type Couplings
  - a. 30 inches and Smaller:
    - 1) Unless otherwise specified, couplings shall be ductile iron or steel construction.
      - a) Standard couplings shall be PowerSeal 3506, Romac XR501 or Krausz Hymax 2, or equal. All to be fusion epoxy lined and coated with stainless steel hardware.
      - b) Flange adaptor to be restrained type rated minimum 235-psi working pressure as manufactured by Sigma (SigmaFlange), Romac RFCA or equal. Body to be fusion bonded epoxy lined and coated with all stainless steel hardware (nuts, bolts, t-bolts).
- 5. Gaskets
  - a. Gaskets shall be designated in Section 15060 – Piping Systems
- 6. Bolts:
  - a. General
    - 1) Bolt Threads shall be ANSI B.1.1, standard coarse thread series;
    - 2) Bolts shall be Class 2A,
    - 3) Nuts shall be Class 2B.
    - 4) Bolt length shall conform to ANSI B16.5.
  - b. Material:
    - 1) Unless otherwise specified, bolts and nuts for submergence or buried applications shall be 316 stainless steel per ASTM F193 heavy hex head.
      - a) Length such that after installation, end of bolts projects 1/8-inch to 3/8 inch beyond outer face of nut. Nuts shall comply with ASTM A194 heavy hex pattern.
      - b) Galvanized or cadmium steel bolts are not acceptable substitutes for stainless steel, regardless of any other protective coatings.
    - 2) Flange assembly bolts for other installations shall be SAE Grade 5, ANSI B18.2.1 standard square or hexagon head carbon steel machine bolts with ANSI B18.2.2 standard hot pressed hexagon nuts.

## B. Fittings

- 1. Ends shall be flanged, mechanical joint, as specified in the Section 15060 – Piping Systems or as shown in the Drawings.

## 2.03 Pipe and Fitting Protection

### A. Lining

- 1. Cement mortar lining to be used only where specifically noted on the drawings or approved by Engineer. Cement mortar lining shall be conforming to ANSI/AWWA C104/A21.4. Mortar lining seal shall be asphaltic coating per ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 for fittings.
- 2. Add,

3. Unless otherwise shown or specified, default lining to be Protecto 401, Tnemec 431 or Permax CTF. Apply lining thickness as recommended by the coatings manufacturer.
4. Where specified, glass lining shall consist of vitreous and inorganic material applied to the internal surfaces that have been prepared by sandblasting. The lining shall be applied in a minimum of two (2) coats, separately applied and coated. The entire coating shall be a minimum of 10 mils and a maximum of 25 mils dry film thickness. Lining shall have a hardness of 5-6 on the MOHS scale and a density of 2.5-3.0 grams per cubic centimeter as measured by ASTM D-792. Repair field cuts per manufacturer's recommendations.

#### B. Coating

1. Buried and Encased Service:
  - a. Asphaltic coating per ANSI/AWWA C151/A21.51 for pipe and ANSI/AWWA C110/A21.10 for fittings.
2. Exposed Service (except as noted on drawings):
  - a. Supply bare pipe – no asphaltic coating.
  - b. Coat per Section 09900 – Protective Coating Systems.
3. Submerged Service:
  - a. Coat per Section 09900 – Protective Coating Systems.

#### C. Polyethylene Encasement

1. Polyethylene encasement shall be used on all buried ductile iron pipe and fittings, including fittings on PVC C900/C905 piping system. Installation of polyethylene shall be as specified in ANSI/AWWA C105/A21.5, Section 5-4.2.1, DIPRA's "Polyethylene Encasement" brochure, and these specifications.
2. Pipe, fittings, valves and couplings shall be wrapped. Fittings that require concrete backing shall be wrapped prior to placing the concrete.
3. The polyethylene encasement seams and overlaps shall be wrapped and held in place by means of a 2-inch wide plastic backed adhesive tape. The tape shall be Polyken No. 900 (polyethylene), Scotchwrap No. 50 (polyvinyl), or equal. The tape shall be such that the adhesive shall bond securely to both metal surfaces and polyethylene film.
4. The polyethylene encasement for recycled water pipe shall be color-coded purple.

#### D. Corrosion Control

1. Where indicated, all lines exceeding 100 feet in length shall be electrically continuous by means of an exothermic weld.
2. Corrosion test stations shall be provided at intervals specified.

### **PART 3 - EXECUTION**

#### **3.01 General**

- A. Piping runs shown on the drawings shall be followed as closely as possible. Proposed deviations shall be submitted in accordance with Section 01330 – Submittals Procedures.
- B. Pipe shall be installed in accordance with AWWA C600. Cuts on DIP pipe shall be coated with an acceptable bituminous material. Cut ends on lined pipes shall be coated in accordance with the approved/specified coating manufacturer's recommendations.

- C. Connections to existing structures and manholes shall be made so that the finished work will conform as nearly as practicable to the requirements specified for the new manholes, including necessary concrete work, cutting and shaping. Concrete mortar shaping within any structure and manhole shall be as specified.
- D. The maximum allowable angular deflection at the joints shall be 80 percent of the manufacturer's recommendation for push-on and mechanical joints.
- E. The Contractor shall conduct the tests in the presence of the Construction Manager.

### **3.02 Connections**

#### **A. General**

- 1. Utilize flanged or grooved-end connections to the fullest extent possible for all field connections. If field grooving is required for extraordinary reasons the Contractor shall document the reasons for review and approval by the Engineer. Contractor shall supply and utilize additional grooved fittings over and above those shown on the drawings as required for field fit up at no additional cost to the Owner.
- 2. Grooved couplings shall be installed in accordance with the coupling manufacturer's installation recommendations.

#### **B. Flanged:**

- 1. Pipe cutting, threading and jointing shall conform to the requirements of ANSI B31.1, and the fitting manufacturer's installation recommendations.
- 2. Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, an insulating section shall be provided as specified.
- 3. Welding of flanges shall be made prior to applying lining.

#### **C. Mechanical Couplings:**

- 1. Mechanical couplings shall be installed in accordance with the coupling manufacturer's installation recommendations.
- 2. Where required for resistance to pressure, mechanical couplings shall be restrained.
- 3. Sleeve Type Couplings
  - a. Sleeve type couplings shall be employed where shown on the drawings, as takedown couplings on large diameter pipelines, to provide flexibility in buried piping systems at connections to structures, and as a general pipe coupling where required or permitted by Section 15055. Unless otherwise provided by the requirements of Section 15055, buried sleeve-type mechanical pipe couplings shall be field coated in accordance with AWWA C210 and 16.2.7 of AWWA Manual M11.

#### **4. Plain or Grooved End Couplings**

- a. Plain or grooved end couplings shall be employed where shown and elsewhere at the Contractor's option consistent with the restrictions set forth in the Specifications. Unless specifically indicated or specified to the contrary, plain or grooved end pipe couplings shall be of the flexible type. Where indicated on the drawings, couplings shall be the grooved end flexible type. Rigid type grooved end pipe couplings shall be employed at all valves or connections to mechanical equipment. Plain or grooved end pipe couplings shall not be employed for buried piping or piping encased in concrete or in suspended ceilings.

#### **5. Flexibility Coupling:**

- a. Piping 2 inches in diameter and larger passing from concrete to earth shall be provided with flexible joints as specified

- 1) within 2 feet of the structure and
- 2) within 3 feet of the first joint.

6. Takedown Couplings:

- a. Shall be screwed unions, flanged or grooved end mechanical coupling type joints.
- b. Flanged or grooved end joints shall be employed on pipelines 2-1/2 inches in diameter and larger.
- c. Where the piping passes through walls, takedown couplings shall be provided regardless of whether or not it is shown on the drawing. The location shall be within 3 feet of the wall or as shown on the Contract Drawings.
- d. A union or flanged connection shall be provided within 2 feet of each threaded end valve.

D. Joints

1. Provide restrained joints as indicated or as required to develop full joint restraint to withstand all working and test pressures.
2. Joints encased in concrete below structures need not be restrained type providing Contractor can show that the concrete encasement will provide the necessary restraint for the piping system.

E. Insulating Sections

1. Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, an insulating section of rubber or plastic pipe shall be provided.
2. Each insulating section shall have a length of 2 to 4 inches.

**3.03 Anchorage**

- A. Anchorage shall be provided as specified. Calculations and drawings for proposed alternative anchorage shall be submitted.

**3.04 Acceptance Testing**

- A. Hydrostatic pressure and leakage tests shall be conducted and acceptability determined in accordance with AWWA C600 as modified by Section 15055 – Piping Materials and Components and Section 15060 – Piping Systems.

**\*\*END OF SECTION\*\***

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## SECTION 15064 PVC PIPE

### PART 1 - GENERAL

#### 1.01 Summary

A. This section specifies polyvinylchloride (PVC) for pressurized and non-pressurized systems.

#### 1.02 References

A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4-in Through 12-in for Water Distribution
ANSI/AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14-in Through 48-in for Water Distribution
ASTM D1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D1785	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
ASTM D2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2464	Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2665	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2466	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fitting, Schedule 40
ASTM D2467	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2665	Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe Fittings
ASTM D2774	Standard Practice for Underground Installation of Thermoplastic Pressure Piping
ASTM D2855	Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings

<b><u>Reference</u></b>	<b><u>Title</u></b>
ASTM D3034	Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D3139	Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F402	Standard Practice for Safe Handling of Solvent Cements, Primers and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
AWWA M23	Manual of Water Supply Practices PVC Pipe – Design and Installation

### **1.03 Submittals**

- A. The following shall be submitted by the Contractor in accordance with the requirements in Section 01330 – Submittals.
1. Alignment/ Layout drawings
  2. Manufacturer's certificates shall be provided with each delivery. This certifies that each pipe section complies with this specification.
  3. Manufacturers' Affidavits of compliance with applicable references
  4. Descriptive literature showing pipe dimensions, joints, couplings and other details for each size of pipe indicated.

### **1.04 Quality Assurance**

- A. The pipe, joints and fittings shall be tested in accordance with the requirements of this specification and as specified in the reference standards. The Contractor shall submit the test results to the Owner's Representative.
- B. Additional sampling may be requested of any material for testing by the Owner at the Owner's expense. The additional samples shall be furnished by the Contractor at no additional cost to the Owner.

### **1.05 Delivery, Storage and Handling**

- A. Delivery
1. Pipe shipment should be carefully inspected by the Contractor upon arrival for defects or damage during delivery.
  2. The Manufacturer shall mark the nominal pipe diameter, pressure class, manufacturer's name, date of extrusion, ASTM designation and PVC Cell Classification on the pipe.
- B. Storage
1. Pipe shall be stored in such a way as to prevent sagging, compression or bending.
  2. Pipe shall be protected from direct sunlight by covering with an opaque material while permitting air circulation.
  3. Gaskets should be stored in a cool, dark place out of direct sunlight.

## C. Handling

1. Handling of the PVC pipe shall be done in accordance with manufacturer's instructions to insure that the pipe is not damaged in any manner during storage, transit, loading, unloading, and installation.
2. Any length of pipe having a gouge, scratch, or other permanent indentation more than 10 percent of the wall thickness in depth shall be rejected.
3. Defective, damaged or rejected pipe shall be immediately removed from the working area and replaced by the contractor at no additional cost to the owner.

### 1.06 Warranty

- A. The pipe shall be warranted to be free of defects in material for a period of one year from substantial completion.

## PART 2 - PRODUCTS

### 2.01 Material

- A. PVC material for pipes and fitting shall complying with Cell Classification 12454-B or better, in accordance with ASTM D1784.
- B. PVC shall be normal impact unless otherwise specified

### 2.02 PVC Non-Pressure Pipe

#### A. SDR 26 and 35

1. Pipe shall meet the requirements of ASTM D2241, ASTM D3034 and ASTM F679.
2. Fittings and Joints
  - a. Push-on:
    - 1) ASTM D3034
    - 2) Gaskets: ASTM F477

#### B. Schedule 40 and 80

1. Pipe shall meet the requirements of ASTM D1785.
2. Fittings and Joints:
  - a. Socket type:
    - 1) Schedule 40: ASTM D2665
    - 2) Schedule 80: ASTM D2467
    - 3) Solvent weld cement for socket type connections: ASTM D2564.

### 2.03 PVC Pressure Pipe

#### A. Schedule 40, 80, and 120

1. Pipe shall meet the requirements of ASTM D1785.
2. Fittings and Joints:
  - a. Socket type:
    - 1) Schedule 40: ASTM D2466

- 2) Schedule 80: ASTM D2467
- 3) Solvent weld cement for socket type connections: ASTM D2564.
- b. Threaded:
  - 1) Schedule 80: ASTM D2464
- c. Flanged:
  - 1) Flanged shall be used for transitions between PVC pipe and pipe of different material
  - 2) Schedule 40/80: See Section 15055, 2.01.
  - 3) Flange bolts for submerged or wet conditions shall be 316 stainless steel.
  - 4) PVC flanges shall be Class 300 conforming to ANSI B16.5 made of material similar to pipe.

B. C900/C905:

1. Pipe shall meet the requirements of AWWA Standard C900/C905, Pressure Class 235 psi (DR-18). For Fire Water Service, Pressure Class 200 psi FM approved. All joints must mechanically restrained.
2. Fittings:
  - a. Ductile iron, see Section 15062
    - 1) Mechanical joint
3. Pipe Joints:
  - a. Push-on:
    - 1) ASTM D3139
    - 2) Push-on gaskets: ASTM F477
4. Restraints:
  - a. Mechanical joint fittings: Romac PVC RomaGrip with Romabond polyester coating and R-Blue (Xylan) coated nuts and bolts or approved equal.
  - b. Integral restrained joint: CertainTeed Certa-Lok, Bull Dog Restraint System, Diamond Lok-21, JM Eagle-Loc, or equal.
5. Sleeve-Type Couplings
  - a. 30 inches and Smaller:
    - 1) Unless otherwise specified, couplings shall be ductile iron or steel construction.
      - a) Standard couplings shall be PowerSeal 3506, Romac XR501 or Krausz Hymax 2, or equal. All to be fusion epoxy lined and coated with stainless steel hardware.
  - b. Flange adaptor shall be restrained type rated minimum 235-psi working pressure as manufactured by Sigma (SigmaFlange), Romac RFCA-PVC or equal. Body to be fusion bonded epoxy lined and coated with all stainless steel hardware (nuts, bolts, t-bolts).

## **PART 3 - EXECUTION**

### **3.01 General**

- A. All installation, jointing, tests for defects and leakage shall be performed in the presence of the Owner's Representative and shall be subject to his approval before acceptance.
- B. All material found to have defects will be rejected and the Contractor shall promptly remove such defective materials from the work site.
- C. Installation shall conform to the requirements of the following standard practices, instructions furnished by the pipe manufacturer, and to the supplementary requirements or modifications specified in this section. Wherever the provisions of this Section and the aforementioned requirements are in conflict, the more stringent provision shall apply.
  - 1. AWWA Manual M23: C900/C905 PVC Pressure Pipe
  - 2. ASTM D2321: SDR 26
  - 3. ASTM D2855 and F402: Solvent welding joining procedure
- D. Unless otherwise specified, paint PVC piping exposed to direct sunlight as specified in Section 09900 – Protective Coating Systems.

### **3.02 Trenching and Backfill**

- A. Trench excavation and backfill shall conform to the requirements of Section 02200 – Earthwork.
- B. Bedding:
  - 1. Unless otherwise shown or required all bedding, initial and final backfill to be Class 2 A.B. Native material is not approved backfill.

### **3.03 Installation**

- A. General:
  - 1. Pipe and fittings shall be of the sizes indicated.
  - 2. Proper implements, tools, and facilities as recommended by the pipe manufacturer's standard printed installation instructions shall be provided and used by the Contractor for safe and efficient execution of the Work.
  - 3. The interior of the pipe shall be cleaned of all foreign matter before installing.
  - 4. The pipe and accessories shall be inspected for defects prior to lowering into the trench. Any defective, damaged or unsound pipe shall be repaired or replaced.
  - 5. All pipe, fittings, valves, and accessories shall be carefully lowered into the trench by means of derrick, ropes, or other suitable equipment in such a manner as to prevent damage to pipe and fittings.
  - 6. Under no circumstances shall pipe or accessories be dropped or dumped into the trench.
  - 7. While laying pipe is NOT in progress, the open ends of the installed pipe shall be closed to prevent trench water from entering into the interior of the pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe that has floated shall be removed from the trench, cleaned, and re-laid in an acceptable manner. The use of burlap, wood, or other similar temporary plugs will not be permitted.
  - 8. No pipe shall be laid when, in the opinion of the Owner's Representative, the trench conditions or the weather are unsuitable for such work.
- B. Field Cutting Pipe

1. Cutting and machining of the pipe shall be accomplished in accordance with the pipe manufacturer's standard procedures for this operation.
2. Pipe shall NOT be cut with a cold chisel, standard iron pipe cutter, wedge type roll cutter or any other method that may fracture the pipe or will produce ragged, uneven edges.
3. Pipe shall be square cut with fine tooth saw or other cutter or knife designed for use with plastic pipe.
4. After cutting, the end of the pipe shall be beveled using a beveling tool, portable type sander or abrasive disc. Remove burrs by smoothing edges with a knife, file, or sandpaper.

C. Field Joining Pipe Joints and Fittings:

1. Pipe shall be jointed in compliance with manufacturer's printed instructions.
2. All pressure pipe shall be suitably restrained by use of thrust blocks or other means as approved by the Engineer.
3. Solvent Weld Joint Type Pipe
  - a. Test fit dry pipe and fittings before applying cement. Pipe should enter socket without forcing at least one-third but not more than two-thirds the depth of socket. Fittings that are looser or tighter shall not be used.
  - b. Thoroughly clean and dry the pipe end and socket of fittings prior to application of solvent.
  - c. Before applying cement, apply primer evenly to outside surface and end of pipe and inside surface of socket.
  - d. Apply cement evenly to outside surface and end of pipe and inside surface of socket. Avoid excess application of cement but insure complete coverage of all bonding surfaces.
  - e. Mark depth of socket on pipe to guide application of cement and insure full insertion of pipe.
  - f. Insert pipe in socket, twisting pipe or fitting approximately 1/2 turn as pipe is being seated in socket. Make sure pipe is fully seated providing a bond between end of pipe and shoulder of socket.
  - g. Immediately wipe excess cement from pipe leaving no more than a 1/8 inch fillet at fitting end. Hold assembled joint in place for approximately 15 seconds and allow to set for 30 minutes before moving. Avoid rough handling for 48 hours. Longer periods may be required in cold or wet weather.
4. Mechanical Joints
  - a. Cut off and remove bevel end of pipe before installing in mechanical joint.
5. Bends, Tees, and Reducers
  - a. Ductile-iron and/or PVC fittings shall be installed utilizing standard installation procedures.
  - b. Cable, rope, or other devices used for lowering fittings into trench shall be attached around the exterior of fitting for handling. Under no circumstances shall the cable, rope or other device be attached through the fitting's interior for handling.

### 3.04 Compaction of Pipe Bedding and Backfill

- A. Compaction of pipe bedding and backfill material shall conform to the requirements of Section 02200 – Earthwork.

### **3.05 Testing**

- A. Field testing of gravity sewer pipe shall be conducted and acceptability determined in accordance with of Section 15055 – Piping Materials and Components and Section 15060 – Piping Systems.

**\*\*END OF SECTION\*\***

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## SECTION 15067 STAINLESS STEEL PIPE

### PART 1 - GENERAL

#### 1.01 Summary

A. This section specifies stainless steel pipe, fittings, connections, and appurtenances.

#### 1.02 References

A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 – Metric/ Inch Standard
ANSI/ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ANSI/ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)
ANSI/ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ANSI/ASME B18.2.2	Square and Hex Nuts (Inch Series)
ANSI/ ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ANSI/ ASME B31.3	Process Piping
ASTM A182/ A182M	Standard Specification for Forged or Rolled Alloy - Steel Pipe Flanges, etc.
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A240/ A240M	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A312/ A312M	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM A403/ A403M	Standard Specification for Wrought Austenitic Stainless Steel Pipe Fittings

<b><u>Reference</u></b>	<b><u>Title</u></b>
ASTM A774 / A774M	Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures
ASTM A778	Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
ASTM F593	Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Standard Specification for Stainless Steel Nuts
ASTM A967	Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
AWS	Welding Handbook, 9th Edition

### **1.03 System Description**

#### **A. Design Requirements**

1. Lay out and fabricated pipe sections with piping as long as possible, while still allowing shipment, so that joints made up in the field are minimized.
  - a. Piping design shown on the Drawings illustrates the general layout and does not indicate the location of every field joint and flexible coupling that may be need to connect piping section fabricated in the shop.
  - b. Add joints and flexible coupling in a manner that achieves intent of maximizing size of individual piping sections.
  - c. Assemble shop-fabricated piping in the field using the joints designed into the piping layout or by using flexible couplings.
  - d. Welding and heat-treating stainless steel piping and appurtenances shall be in accordance with the AWS. Austenitic stainless steels including 316 shall be shop welded and heat-treated to alleviate sensitization. Field welds may be performed on martensitic or ferritic grades of stainless steel, or on 316L (carbon content below 0.03 percent) upon approval of the Engineer.

### **1.04 Submittals**

#### **A. The Contractor shall submit the following in accordance with Section 01330 – Submittals Procedures:**

1. Shop drawings
2. Alignment/ layout drawings
3. Manufacturers' affidavits of compliance with applicable references.
4. Manufacturer's product data including size, type, weight, gasket materials, materials standards and installation requirements for pipe, connections and fittings
5. Certification that such length of pipe has been tested physically for ductility and has satisfactorily passed such tests and inspections.
6. If applicable, Manufacturer's welding procedure specifications and certification of welder performance qualifications.
7. Fabricator's pickling and passivation procedures.
8. Field pickling and passivation procedures.

## **1.05 Quality Assurance**

### **A. Testing**

1. Factory testing shall conform to the standard requirements of all applicable references.

## **PART 2 - PRODUCTS**

### **2.01 Pipe**

- A. Stainless steel pipe shall be Type 316L as indicated in the drawings. The pipe schedule shall be Schedule 40S.
- B. Type 316L stainless steel shall conform to ASTM A240.
  1. Piping 3 inches nominal diameter and larger shall be manufactured according to ASTM A778.
  2. Piping less than 3 inches nominal diameter shall be manufactured according to ASTM A312.

### **2.02 Connections and Fittings**

#### **A. Connections**

##### **1. General**

- a. Connections shall be as specified in Section 15055 – Piping Materials and Components, as shown on the Contract Drawings and as follows.

##### **2. Threaded:**

- a. Pipe thread dimensions and size limits shall conform to ANSI B1.20.1

##### **3. Flange Assemblies:**

- a. Stainless steel flanges shall be butt weld, Type 316L per ASTM A182, Class 150-lb to match the piping material of each piping system.
- b. Insulating Flange Joints:
  - 1) Insulating flange joints shall have 1/6-inch thick plastic, full length bolt sleeves, with 1/8 inch thick insulating washers and flat washer for each flange bolt.

##### **4. Grooved End Couplings:**

- a. Cut grooves are not permitted.
  - 1) Grooves shall be rolled to conformance with manufacturer's specifications.
- b. Coupling shall be Type 316L stainless steel (to match piping system material)
- c. Unless otherwise specified, grooved end couplings shall be the flexible type
  - 1) Victaulic Style 77s, Gruvlok Figure 7001SS, or equal
- d. Where shown, rigid-type couplings shall be
  - 1) Victaulic Style 489, Gruvlok Figure 7400SS, or equal

##### **5. Gaskets:**

- a. Gaskets designated in Section 15060 – Piping Systems

##### **6. Bolts:**

###### **a. General**

- 1) Bolt Threads shall be ANSI B.1.1, standard coarse thread series;

- 2) Bolts shall be Class 2A
  - 3) Nuts shall be Class 2B.
- b. Material:
- 1) Bolts and nuts shall be 316 stainless steel per ASTM F193 heavy hex head.
    - a) Length such that after installation, end of bolts projects 1/8-inch to 3/8 inch beyond outer face of nut. Nuts shall comply with ASTM A194 heavy hex pattern.
    - b) Galvanized or cadmium steel bolts are not acceptable substitutes for stainless steel, regardless of any other protective coatings.

## B. Fittings

1. Unless otherwise specified, all fittings shall be rated for pressure and loadings equal to the pipe.
2. Fitting material and schedule thickness shall conform to the pipe material and schedule thickness where the fittings are installed.
3. Manufacturing Standard
  - a. 3 inches in nominal diameter and greater: ASTM A774
  - b. Less than 3 inches in nominal diameter: ASTM 403, Type CR or WPW to match the piping of the particular system
4. 3 inch and larger:
  - a. Reducers shall be concentric, butt weld or flanged type as shown on the drawings.
  - b. Elbows shall be of the short radius, flanged or butt weld type as shown on the drawings.
  - c. Tees shall have the three ports of the same size, each port suitable for butt welding or flanged as shown on the drawings.
5. 2 ½ inches and smaller:
  - a. Pressure rating: Class 150 except half couplings which shall be Class 300
  - b. Fittings ends: Threaded, NPS (dry), NPT (wet), dimensions to conform to ANSI B16.3
6. Flanged Coupling Adapters: Use Baker flanged coupling adapter with 316 SST flange restraint lug.
7. Dismantling Joints: Use Baker 316 SST or Dresser 316 SST dismantling joint, or equal.

## 2.03 Fabrication

### A. General

1. Stainless steel fabrications shall be free from pits, cracks, crevices, oxidation, weld splatter, stains, and discoloration.
  - a. Surfaces shall be clean and of uniform appearance.

### B. Pipe

1. Pipe 12 inches and less in diameter shall be automatically welded using gas tungsten-arc procedures.
2. Piping 4 inches through 12 inches in diameter shall be double butt-welded.
3. Piping less than 4 inches in diameter shall be single butt-welded.
4. Pipe shall be round and true.

### C. Fittings

1. Fittings shall be welded with Type 316L filler metal to match the piping or fitting material of each piping system.
2. Fitting dimensions shall be in accordance with ANSI B16.9, and shall be terminated and dimensioned as indicated on the Drawings.
3. Elbows 24 inches and smaller in diameter shall be die formed and shall be automatically welded, using gas tungsten-arc procedures with inert gas backing.
4. Tees, crosses, true Y's and laterals shall be nozzle welded, using manual shielded metal arc procedures and double welds.
5. Reducers shall be cone type.
6. Unless otherwise indicated on the Drawings, spools shall be terminated with flanged ends, and face to face dimensions shall be determined by pipe fabricator.

### D. Welding for Pipe and Fittings

1. Welding shall be as specified in sections 15055, and as noted in this paragraph.
2. Manufacturer shall submit documentation of welding procedure specifications and certification of welder performance qualifications. Welding procedures and welder certification shall conform to ASME Section IX and AWS B2.1.
3. Weld seams shall have full penetration and be free of oxidation, crevices, pits, cracks, protrusions, overlaps, and cold laps.
  - a. Weld seams shall be without undercuts.
  - b. Weld crowns shall be 1/16 inch with a tolerance of plus 1/16 inch or minus 1/32 inch.
4. Longitudinal welds on fittings, except elbows, shall be accomplished by the same procedures as for pipe.
5. Pipe spools shall be manually welded with Type 316L filler metal to match the piping system:
  - a. Where internal weld seams are not accessible, gas tungsten-arc procedures with internal gas purge shall be used.
  - b. Where internal weld seams are accessible, seams shall be welded inside and outside using manual shielded metal-arc procedures.
6. Welding procedures shall minimize the formation of heat tint oxides. The fabricator shall submit proof of welding procedures to minimize or eliminate heat tint oxides and shall demonstrate the ability to make heat-tint-free welds.

E. Following fabrication, pipe, spools, fittings, and other shop fabricated pieces shall be pickled and passivated in accordance with ASTM A380 or ASTM A967 by immersion in sulfuric acid solution followed by immersion in a nitric-hydrofluoric bath and subsequent wash at the proper temperature and length of time to remove heat tint oxide, free iron, weld scale, and other impurities; and to obtain a passive finished surface.

F. Heat tint oxides formed during welding which cannot or were not removed by nitric-hydrofluoric acid both shall be removed by approved mechanical means.

## **PART 3 - EXECUTION**

### **3.01 Installation**

#### **A. Pipe**

1. Pipe shall be installed in accordance with AWWA M11, Chapter 12.
2. Flanges shall be provided at valves, tees, drip legs, and flowmeter, and equipment locations.
3. Anchorage shall be provided as specified. Calculations and drawings for proposed alternative anchorage shall be submitted in accordance with Section 01330.
4. Protect pipe from damage from weld splatter, paint overspray and mechanical damage after installation.
5. Mist pipe with clean water to detect presence of ferrous material. Clean pipe to remove all markings, weld splatter, ferrous material, paint or other deleterious material.

#### **B. Fittings**

1. Fittings shall be installed in accordance with the manufacturer's recommendations.

#### **C. Connections**

1. Threaded Connections:
  - a. Pipe cutting, threading and jointing shall conform to the requirements of ANSI B31.1, and the fitting manufacturer's installation recommendations
2. Flanged Connections
  - a. Pipe cutting, threading and jointing shall conform to the requirements of ANSI B31.1, and the fitting manufacturer's installation recommendations.
  - b. Where a metallic nonferrous pipe or appurtenance is connected to ferrous pipe or appurtenance, an insulating section shall be provided as specified.
3. Mechanical Coupling Connections:
  - a. Mechanical couplings shall be installed in accordance with the coupling manufacturer's installation recommendations.
4. Welded Connections:
  - a. Field welding of stainless steel pipe will not be permitted except in limited instances as approved by the Engineer.
  - b. The Contractor shall utilize flanged, grooved-end, or threaded (where permitted) connections to the fullest extent possible for field connections. If field welds are required for extraordinary reasons the Contractor shall document the reasons for review by the Engineer.
  - c. Restrained flexible couplings may also be utilized, space permitting, to allow field alignment of pipe.
  - d. All field welds shall be subjected to x-ray testing. Where welding of stainless steel pipe is permitted by the Engineer, pipe shall be welded by ASME-certified welders.
  - e. Welds shall be made in accordance with the requirements of ASME Section IX, ANSI B31.1, ANSI B31.3, or AWWA C206.
  - f. Contractor shall remove all heat tint oxides, weld spatter, and markings from pipe.
5. Takedown Couplings:

- a. Takedown couplings shall be threaded unions, flanged or grooved end mechanical coupling type joints and shall be provided as specified and as shown on the drawings.
  - 1) Flanged or grooved end joints shall be employed on pipelines 2-1/2 inches in diameter and larger.
  - 2) Where piping passes through walls, takedown couplings shall be provided within 3 feet of the wall, unless specified otherwise.
  - 3) A union or flanged connection shall be provided within 2 feet of each threaded end valve.
- 6. Flexibility:
  - a. Unless otherwise specified, piping 2 inches in diameter and larger passing from concrete to earth shall be provided with pipe couplings or flexible joints as specified or as shown on the drawings
    - 1) Within 2 feet of the structure and
    - 2) Within 3 feet of the first joint
  - b. Where required for resistance to pressure, mechanical couplings shall be restrained in accordance with AWWA M11, paragraph 13.10, Tables 13-6 and 13-7, and Figure 13-17.

### **3.02 Field Quality Control**

#### **A. Welding Inspection**

- 1. Welds shall be inspected by Contractor as specified below:
  - a. A visual inspection for crevices, pits, cracks, protrusions, or oxidation deposits shall be grounds for rejection of the joint or item in which found.
  - b. Three percent of the welds shall be examined by X-ray methods at the point of fabrication.
    - 1) For each weld found to be defective by X-ray methods, three additional welds shall be examined using the same method.
    - 2) Interpretation of X-ray pictures shall be made by an independent testing laboratory acceptable to Engineer, and a written report of the findings issued by the laboratory shall be submitted to Engineer.

### **3.03 Testing**

- A. Hydrostatic testing shall be in accordance with Section 4 of AWWA C600 except that test pressures and allowable leakage shall be as listed in Section 15055 – Piping Materials and Components.
- B. After hydrostatic testing has been completed on any given stainless steel piping system section, the Contractor shall promptly drain that section and provide air to dry the interior. After the drying is complete, the stainless steel piping section shall be closed off until it is placed in service.

**\*\*END OF SECTION\*\***

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## SECTION 15069 REINFORCED CONCRETE PIPE

### PART 1 - GENERAL

#### 1.01 Summary

A. This section specifies reinforced concrete pipe.

#### 1.02 References

A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/ASME C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ANSI/ASME C361	Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
ANSI/ASME C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ANSI/ASME C497	Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
ANSI/ASME C655	Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ANSI/AWWA C302	Standard for Reinforced Concrete Pressure Pipe, Noncylinder Type
ANSI/AWWA C651	Standard for Disinfecting Water Mains
ANSI/AWWA M9	Installation of Concrete Pipe

#### 1.03 Submittals

A. The Contractor shall submit the following in accordance with Section 01330 – Submittals Procedures:

1. Shop drawings
2. Manufacturers' Affidavits of compliance with applicable references.
3. Manufacturer's product data to include size, type, weight, gasket materials, materials standards and installation requirements for pipe, connections and fittings.
4. Manufacturer's installation instructions
5. Concrete materials
  - a. Chemical and physical properties.
  - b. Mix design.
6. Reinforcement cage and steel cylinders for special designs not utilizing table values contained in references standards.
  - a. Chemical and physical properties.

- b. Area of steel.
- c. Cage configuration.
- 7. Joint details.
- 8. Connection details.
- 9. Tabulated laying schedule.
  - a. Reference to project stationary and invert elevations.
  - b. Identify pressure zones, each of design pressure or transient loading zones applicable, and point of change from one (1) zone to another.
  - c. Pipe diameter.
  - d. Pipe wall thickness.
- 10. Test reports: Include six (6) copies of D (0.01) - Load and Failure Test Reports, cylinder compression test results, and joint tests
- B. For each pipe, fitting, special appurtenance with a plainly and permanently waterproofed marked identification:
  - 1. Size and class of pipe, pressure rating in compliance with referenced standards.
  - 2. Date of manufacture.
  - 3. Manufacturer's trademark.
  - 4. Manufacturer's name.
  - 5. Full details on fittings and pipe schedule regarding angles of change, reduction.
  - 6. Special notations and tagging of special items in regard to line location.

#### **1.04 Quality Assurance**

##### **A. Testing**

- 1. Factory testing shall conform to the requirements of all applicable references.
- 2. Conduct testing methods to evaluate physical properties of pipe in full compliance with ASTM C497.
  - a. Report full results test showing compliance with referenced standard.
- 3. Determine acceptability of RCP in all diameters and classes by appropriate ASTM plant tests, including such test to indicate specified design strengths have been met prior to shipment.
  - a. Conduct three-edged bearing test as specified to determine the loading to produce a 0.01 inch crack extending 12 inch or more.
    - 1) Complete bearing test prior to shipment date of lot tested.
  - b. Conduct crushing test, as specified on cured concrete cylinders.
    - 1) Achieve specified 28-day design compressive strength prior to shipment date of lot tested.

## **PART 2 - PRODUCTS**

### **2.01 Pipe**

- A. Pipe design, materials, and manufacture shall comply with the latest revision of the following documents:

### **2.02 Fabrications**

- A. Provide non-pressure service, low pressure service or gravity drainage piping meeting or exceeding ASTM C76, Class 3 with varying lengths a minimum of 7 FT long.
  - 1. Each lot shall consist of a single diameter and strength designation manufactured by essentially the same process.
  - 2. Ensure that the rubber gasket will perform as the sole element to make the joint watertight.
- B. Provide RCP for non-pressure service or gravity drainage with sealed joints using continuous rubber gaskets conforming to the requirements of ASTM C443 or ASTM C361.
  - 1. Type of joint shall be spigot groove type joint with O ring gaskets, rubber/cement
    - a. United States Bureau of Reclamation Type R/4.

## **PART 3 - EXECUTION**

### **3.01 General**

- A. Piping runs shown on the drawings shall be followed as closely as possible. Proposed deviations shall be submitted in accordance with Section 01330 – Submittals Procedures.
- B. Pipe shall be installed in accordance with AWWA M9 for installation, delivery, and storage of pipe materials
- C. Connections to existing structures and manholes shall be made so that the finished work will conform as nearly as practicable to the requirements specified for the new manholes, including necessary concrete work, cutting and shaping.
- D. The Contractor shall conduct the tests in the presence of the Construction Manager.

**\*\*END OF SECTION\*\***

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# SECTION 15090 PIPE SUPPORTS

## PART 1 - GENERAL

### 1.01 Summary

- A. The work of this Section includes designing and providing pipe supports, hangers, guides, and anchors.
- B. Related Sections: The work of the following Sections applies to the work of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this work.

<u>Section</u>	<u>Title</u>
09900	Coating Systems
15055	Piping Materials and Components

### 1.02 References

- A. This section contains references to some or all of the following documents, most recent edition. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

<u>Reference</u>	<u>Title</u>
ANSI/ASME B31.1	Power Piping
ANSI/MSS SP-58	Standard Pipe Support Components

### 1.03 System Description

- A. Design Requirements
  - 1. More stringent of
    - a. California Building Code
    - b. Applicable National Code
  - 2. Supports shall be capable of supporting the pipe for all service and testing conditions.
  - 3. Supports shall allow free expansion and contraction of the piping throughout the full operating temperature range to prevent excessive stress.
  - 4. Supports and hangers shall be designed to allow for proper pitch of pipes.
  - 5. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors shall meet the following standards, except as modified by this Specification:
    - a. ANSI B31.3
    - b. MSS SP-58 and SP-69
  - 6. For hot and cold water piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors shall meet the following:
    - a. ANSI B31.1

- b. MSS SP-58 and SP-69
- 7. All physical clearances between piping, support system and structure shall be checked and the supports shall allow for vertical adjustment after erection.
- 8. Vertical pipe runs in pipe chases shall be supported at base of riser. Pipes shall be supported for lateral movement with clamps or brackets.
- 9. Galvanized 20-gauge steel pipe saddle shall be provided for plastic support points to ensure minimum contact width of 4 inches.
- 10. Pipe Support Spacing
  - a. General
    - 1) For conditions not detailed on the drawings, Contractor is responsible for a complete pipe support system.
    - 2) Pipe supports shall be designed by the Contractor. In all cases pipe supports shall not exceed maximum spacing scheduled unless otherwise shown.
    - 3) All piping shall be supported to prevent undue strain on any valve, fitting or piece of equipment.
    - 4) Locations
      - a) All changes in direction
      - b) All changes in elevation
      - c) Adjacent to flexible couplings
      - d) At least one support shall be provided for each length of pipe and each valve
  - b. Each length and every fitting shall be supported as follows:
    - 1) Bell and spigot piping
      - a) At least one hanger
      - b) Applied at bell
    - 2) Compression sleeve joints:
      - a) Hanger shall be within 2 feet of each side of fittings to keep pipes in alignment.
  - c. Supports shall be spaced for soil and waste pipe and other piping systems not included above every 5 feet.
  - d. Continuous support shall be provided for nylon tubing

#### **1.04 Submittals**

- A. The Contractor shall submit the following in accordance with Section 01330 – Submittals:
  - 1. Shop drawings for all fabricated pipe supports
  - 2. If there are locations where the Contractor deviates from the pipe supports shown on the Contract Drawings; including details of concrete inserts, the Contractor shall submit a drawing showing the deviations.
- B. Submit pipe support design calculations, including seismic calculations per Section 01330 – Submittals and as follows in this section.

## **PART 2 - PRODUCTS**

### **2.01 Materials**

A. Pipe supports shall be fabricated from the following materials:

1. Stainless steel (Type 304L or 316L):

a. Use in all submerged locations or in tanks above the water level but below the top of the structure and where specifically indicated on the Drawings.

2. Plastic, FRP and Other Miscellaneous Materials:

a. Use where indicated on the Drawings.

### **2.02 Manufactured Units**

A. Products listed in this section refer to products manufactured by Anvil International. Equivalent units manufactured by Tolco, B-Line, or equal, may be substituted.

B. Supports and Anchors

1. For exposed and submerged conditions, stainless steel, Type 304L, shall be used except as noted.

C. Contact between dissimilar metals shall be prevented by the use of copper plated, rubber, vinyl coated, or stainless steel hangers or supports.

D. Modular Framing Strut Systems and Accessories for Pipe Support

1. Galvanized steel or stainless steel as specified

2. 12-gauge channels

3. Unistrut, Globestrut, Anvil-strut, Powerstrut, or equal

## **PART 3 - EXECUTION**

### **3.01 Installation**

A. Piping systems exhibiting pulsation, vibration, swaying, or impact shall be provided with suitable constraints to correct the condition. Included in this requirement are movements from:

1. Trap discharge

2. Water hammer

3. Similar internal forces

B. Weld Supports

1. AWS D1.1

2. Anchors shall be welded to pipe in accordance with ANSI B31.3

C. Piping and pipe supports shall be located so as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.

D. Hangers shall be inspected for:

1. Design offset

2. Adequacy of clearance for piping and supports in the hot and cold positions

3. Guides to permit movement without binding

4. Adequacy of anchors

- E. Hangers shall be inspected after erection of piping systems and prior to pipe testing and flushing.
- F. Individual or continuous slot concrete inserts for use with hangers for piping and equipment shall be installed as concrete forms are installed.
- G. Field painting shall comply with Section 09900 – Protective Coating Systems.
- H. All piping shall be braced for seismic forces in accordance with CBC.
- I. All galvanized pipe supports used to support stainless steel piping shall be provided with a rubber bushing material to isolate the galvanized supports from the stainless steel pipe.

**\*\*END OF SECTION\*\***

## **SECTION 15100 VALVES & MISCELLANEOUS COMPONENTS**

### **PART 1 - GENERAL**

#### **1.01 Summary**

A. This Section includes valves and miscellaneous components.

#### **1.02 Submittals**

- A. Annotated Product Bulletins for all valves, miscellaneous components, and accessories utilized.
- B. Shop Drawings for all valves and appurtenances shall be submitted with a complete bill of materials indicating valve type, material class, factory coatings, exploded views, sections, and other catalog and engineering data showing compliance with the specified requirements.
- C. Installation, operating and maintenance manuals for all valves, miscellaneous components, and accessories utilized.
- D. Warranty Statements
- E. Certifications of manufacturing quality and standard compliance.
- F. For each type and model of valve provide:
  - 1. Assembly instructions, and
  - 2. Recommended coating system to protect the equipment from the service and exposure conditions shown on the drawings.
  - 3. For each motor driven actuator, provide motor currents at the specified voltage for each actuator, corresponding to locked rotor, maximum seating torque, average running load and speed. Supplier shall give full information concerning actuator dimensions and weights.
- G. Where electric actuators are shown on the drawings provide the submittal for the electric actuator with the submittal for the valve. See Section 15145 for submittal requirements.

#### **1.03 Delivery, Storage, and Handling**

- A. All valves and miscellaneous items shall be packed, shipped, stored and handled in accordance with manufacturer recommendations.
- B. Protection during Shipment
  - 1. Each item of equipment shall be shipped to the site of the work with either the manufacturer's shop applied prime coating or a vinyl paint prime coating. The prime coating shall be applied over clean dry surfaces in accordance with the paint manufacturer's recommendations. The prime coating will serve as a base for field-applied finish coats.
  - 2. Bearing housings shall be wrapped or otherwise sealed to prevent contamination by grit and dirt, and ventilation and other types of openings shall be taped closed.

#### **1.04 Quality Assurance**

- A. Supplier's shall have been manufacturing respective valves and components for a period of at least ten years. At the engineer's request, supplier shall provide a list of installations involving equipment of similar size and application.
- B. Each valve and actuator shall be assembled, adjusted and tested as a unit by the valve manufacturer.

## 1.05 Warranty

- A. Provide manufacturer's written warranty, issued in the Owner's name, to cover the equipment supplied against defects in workmanship and material for a period of one (1) year from the date of acceptance under normal use and service. Warranty shall include all materials and labor required.

## PART 2 - PRODUCTS

### 2.01 General

#### A. Pressure Rating

1. All process valves shall be rated for a working pressure equal to or greater than the pressure rating of the connecting piping, unless piping was chosen specifically for a reason other than pressure rating, in which case the max pressure within the piping will supercede this requirement.
2. In no case shall the working pressure rating be less than the field test pressure.

#### B. Connectors

1. Valve Connectors shall be flanged, threaded, socket, grooved, or mechanical joint type unless otherwise shown on the plans. All valve connectors shall be restrained

#### C. Operators

1. Operators shall be sized based on the maximum expected torque as per valve manufacturer's recommendations. The responsibility for proper operation shall reside with valve supplier unless specifically indicated in the Contract Drawings.

#### D. Manual Operators

1. All valves, except check valves and air/vacuum valves, shall be provided with manual operators unless otherwise specified.
  - a. The operator shall be either levers or handwheels opened in the counterclockwise direction, unless otherwise indicated.
  - b. Each valve body shall have cast thereon the word OPEN and an arrow indicating the direction to open.
  - c. Valves mounted higher than 6 feet above floor or operating level shall have chain operators.
  - d. Unless otherwise indicated, valves of sizes 8-inch and larger shall have gear-assisted operators

#### E. Buried Valves

1. Where buried, valves shall have extensions with square nuts.
  - a. Extended wrench nuts shall be provided so that the nut shall be within 40 inches of the cover.
  - b. Wrench nuts shall comply with Section 19 of AWWA C500.
  - c. A minimum of two operating keys, but no less than one key per every ten valves, shall be provided.
  - d. Provide valve boxes for all buried valves.

**2.02 Butterfly Valves**

- A. Valves shall be rubber seated, tight closing type. Butterfly valves and all accessories, including operators, shall meet the requirements of AWWA C504, except as otherwise specified. Valve bodies shall be short- or long-body flanged type, or mechanical joint. Valve bodies shall be flanged or mechanical joint type, unless otherwise shown. If wafer type valves are specifically shown or noted, provide body with drilled and tapped lugs. Wafer body type valves without lugs are not acceptable.
- B. Provide gear operator, wrench nut and valve box on all buried butterfly valves.
- C. Valve discs shall rotate 90 degrees from full open position to the tight shut position.
- D. The valve seat shall provide a tight shutoff at a pressure differential of 150 psi upstream and 0 psi downstream in either direction.
- E. Butterfly valve pressure classes shall be not less than Class 150B, shall exceed the test pressure for the pipeline in which the valve is installed, or shall be as specified, whichever is greater.
- F. Valves shall be constructed of materials resistant to corrosion for the required service. Valve exterior shall be epoxy coated per AWWA C550. Valve materials shall be as specified below or as required for the service:

<b>Component</b>	<b>Material</b>	<b>Standard Specification</b>
Body	Cast Iron	ASTM A126 CLASS B ASTM A48 CLASS 40
Shafts	Stainless Steel	ASTM A276 Type 316 Stainless Steel
Discs	Stainless Steel Ductile Iron	316 Stainless Steel Disc ASTM A743 or Ductile Iron ASTM A536 (65-45-12).
Mating Seat Surface	Stainless Steel Castings Stainless Steel Alloy Cast Iron	A296 Grade CF-8 or CF-8M A276 or A479, Type 316 A436 Type 1
Seats	Rubber or Buna-N	

- G. If stub shafts are furnished, the shafts shall extend a minimum of 1-1/2 diameters into the discs and the clearance between the shaft and the discs shall not exceed the following:

<u>Shaft Diameter, inches</u>	<u>Maximum Radial Clearance, inches</u>
1/2 to 1-1/2	0.002
2 to 4	0.0025

- H. Manufacturers/Models: DeZurick, Crispin, or approved equal.

**2.03 Aeration Butterfly Valves**

- A. Valves shall be general purpose resilient seated butterfly valve with a lugged body design.

- B. Provide gear operator, wrench nut and valve box on all buried butterfly valves.
- C. Valve discs shall be an offset shaft design to provide uninterrupted 360° sealing. Discs shall be designed with a concave face to minimize dynamic torque, decrease turbulence and maximize flow capacity. Discs shall be 316 stainless steel ASTM A351 Grade CF8M or other materials as specified.
- D. The valve seat shall be of 316 Stainless Steel. Seat design shall be pressure assisted and mechanical seat-to-disc sealing features capable of ANSI/FCI 70-2 IV and V unidirectional shutoff.
- E. Butterfly valve pressure classes shall be not less than Class 150B, shall exceed the test pressure for the pipeline in which the valve is installed, or shall be as specified, whichever is greater.
- F. Disc-to-Shaft Connection shall be subject to compression forces only through the use of a tangential pin or torque plugs. Designs using shear or through-pin connections are not allowed. All valves shall have blow-out proof shaft connections.
- G. Valve Shaft shall be a one-piece design and shall be centerless ground to minimize bearing and packing wear. Shaft material shall be 2205 Duplex stainless steel ASTM A479 or other material as specified.
- H. Valve Bodies shall be constructed of Carbon Steel ASTM 216 Grade WCB or 316 Stainless Steel ASTM A351 Grade CF8M or other materials as specified. The valve body shall be cast lugged or wafer configuration with a minimum of four guide holes.
- I. Adjustable Packing shall be multiple v-ring PTFE or braided carbon graphite including anti-extrusion ring. Valve shall permit inspection, adjustment or complete replacement of packing without disturbing any part of the valve or actuator assembly except the packing follower.
- J. Manufacturers/Models: DeZurik or approved equal.

**2.04 Gate Valves**

- A. Gate valves 3 inches and larger shall be non-rising, resilient-wedge or resilient-seated, and shall comply with AWWA C509.
- B. Provide valve box for all buried gate valves.
- C. Gate valve end connections shall be flanged. Flanges shall be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1 for 125-pound flanges.
- D. Buried valves shall be supplied with a 2” square operating nut.
- E. Valves shall be supplied with O-ring seals at all joints.
- F. Stems shall be cast bronze with integral collars in full compliance with AWWA. The stem stuffing box shall be the O-ring seal type with two O-rings located above the thrust collar and one O-ring below.
- G. There shall be two low torque thrust bearings located above and below the thrust collar. The stem nut shall be independent of the wedge and shall be made of solid bronze.
- H. There shall be a smooth and unobstructed waterway free of all pockets, cavities, and depressions in the seat area.
- I. Gate valves shall be of the non-rising stem type unless noted otherwise. Non-rising stem valves shall be provided with O-ring stem seals. The body shall be provided with screwed-on seat rings.
- J. Materials of construction shall be as follows:

Components	Material
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Body	Ductile Iron
Wedge	Ductile Iron, full rubber encapsulated
Stem and Stem Nut	Bronze, AWWA C500, Section 3.12 or Stainless Steel

- K. Coatings: The body and bonnet shall be lined and coated with a fusion bonded epoxy complying with AWWA C550.
- L. Manufacturers/Models: American AVK Series 65 Resilient Wedge, Clow Valve Company Model 2639, Mueller A-2361 RS Series, or equal.

**2.05 Plug Valves**

- A. Plug Control valves with electronic on/off actuators shall be provide downstream of the RAS/WAS Pump Station. See Section 15145 – Electric Actuators.
- B. Plug valves shall be compliant with AWWA C517, non-lubricated eccentric plug valve type suitable for drip tight, bi-directional shutoff at a minimum rated valve design pressure of 175 psig for valve sizes ½” to 12” and 150 psi for valve sizes 14” and larger.
- C. Plugs shall be solid one piece, Cast Iron ASTM A126 Class B or Ductile Iron ASTM 536 Grade 65-45-12. The plug shall have a cylindrical seating surface eccentrically offset from the center of the shaft. Plug shall not contact the seat until at least 90% closed. Resilient plug facing shall be Chloroprene (CR). Spherical shaped plugs are not acceptable.
- D. End connections shall meet or exceed the latest revisions of AWWA C517 and other applicable standards. End Connections shall be Flanged drilled per ASME B16.1 and/or Mechanical Joint per AWWA C111.
- E. Bodies and covers shall be Cast Iron ASTM A126 Class B. The plug valves shall be round ported, or rectangular where approved by the Engineer. Provide rectangular ports design on valves 14” and larger. All valves shall be capable of being “pigged” with a soft pig when required. Valve bodies shall be of ASTM A-126 Class B cast iron in accordance with AWWA C-517.
- F. The bonnet shall be of bolted construction.
- G. Plug valves shall be flanged ends and drilled to ANSI B16.5 class 150 or mechanical joint ends for buried service.
- H. Bearings shall be sleeve type and made of sintered, oil impregnated permanently lubricated type 316 stainless steel for sizes 4-18” (100-450mm) and ASTM A743 Grade CF8M for sizes 20-36” (500-800mm). In valves larger than 36” (900mm), the upper and lower plug journals shall be fitted with ASTM A240 type 316 stainless sleeves with body bearings of ASTM B30, Alloy C95400 aluminum bronze.
- I. Materials of construction shall be as follows:

<b>Components</b>	<b>Material</b>
Body	ASTM A126, Class B or Ductile Iron ASTM A536 65-45-12
Body Bearing	ASTM A276 Grade 316 SST
Plug	Ductile Iron A536, Grade 65-45-12
Resilient Plug Facing	Chloroprene or Buna-N rubber
Thrust Bearing	PTFE

Gasket	Non-asbestos filler in Styrene-Butadiene Rubber Binder
Bonnet	Cast Iron, ASTM A126, Class B
Bonnet Bearing	ASTM A276 Grade 316L SST
Bonnet Screws	Carbon Steel, Grade 2, Zinc Plated
Packing	NBR Acrylonitrile-Butadiene, V-type
Gland	Cast Iron
Gland Stud	Zinc Plated
Nuts, bolts, springs and washers	Zinc Plated for exposed service, 304 Stainless steel for buried service

J. Design of the valve components shall conform to the following:

1. Valve Packing: AWWA C504, Section 3.7 and C507, Section 10
2. Valve seats: AWWA C504 Paragraph 3.5 and C507 Paragraph 7.2.
3. Bearings: AWWA C504 Section 3.6.
4. Plug Valves shall be in full conformance with the latest revision of the AWWA C517 standard

K. All valves larger than 6" shall be installed with worm gear actuators. All gearing shall be enclosed in a cast iron housing, with outboard seals to protect the bearings and other internal components. The actuator shaft and gear quadrant shall be supported on permanently lubricated bronze bearings.

L. Operators:

1. Equip valves 6 inch nominal size and larger with handwheel operated actuators for exposed applications, unless otherwise indicated in the plans. Handwheels shall be 16-inch diameter minimum.
2. Equip valves 4 inch nominal size and smaller with lever operator.
3. Provide nut operators for buried applications with position indicators.

M. Coating: Plug valves shall be NSF approved 2 part epoxy coated to an 8 mil minimum thickness (dry).

1. Coatings shall conform to AWWA C550 for all interior and exterior surfaces.
2. Contractor shall coat the exterior of valve per Section 09900 – Protective Coating Systems to match piping system color, or color per Owner's approval.

N. Manufacturers/Models:

1. Plug Valves:
  - a. GA Figure 517 Eco-Centric
  - b. Dezurik PEC Eccentric Plug Valves,
  - c. Crispin Plug Valves,
  - d. Clow
  - e. or equal.
2. Position Indicators:

- a. Position Indicators shall be Trumbull Industries,
- b. or equal.

## **2.06 Ball Valves**

### **A. General**

- 1. Unless otherwise indicated on the Drawings use:
  - a. Metal body ball valves on metallic pipelines.
  - b. Plastic body ball valves on plastic pipelines.
- 2. Do not use metal body ball valves in sodium hypochlorite or sodium bisulfite systems.

### **B. Metal Ball Valves**

#### **1. General:**

- a. Type: Non-lubricated, full port and capable of sealing in either direction.
- b. Ball valves up to 1-1/2 inches in size shall have a pressure rating of not less than 300 psi. Valves 2-inch to 4-inch in size shall have a pressure rating of 250 psi.
- c. Valves shall have manual operators with lever or handwheel.
- d. End connections:
  - 1) Threaded or solder ends for sizes 3-inch and smaller.
  - 2) Class 150 flanged for sizes larger than 3 inch.
    - a) Flanges: In accordance with ASME B16.1 standards.
- e. Stem packing: Manually adjustable while valve is under pressure.
- f. Shafts:
  - 1) Rigidly connected to the ball by a positive means.
    - a) Design connection to transmit torque equivalent to at least 75 percent of the torsional strength of the shaft.
- g. Handles: Stainless steel latch lock handle with vinyl grip and stainless steel nut designed to open and close the valve under operating conditions.
- h. The valve stems shall be of the blow-out proof design, and fabricated of bronze or Type 316 stainless steel and shall include reinforced Teflon seals.
- i. Temperature limits: Suitable for operation between minus 20 and 350 degrees Fahrenheit.

#### **2. Materials:**

- a. Valves in copper lines: Bronze body.
  - 1) For potable water applications bronze valves made with copper alloy (brass) shall contain no more than 15 percent zinc.
- b. Valves in steel and ductile iron piping: Ductile iron or cast steel body.
- c. Valves in stainless steel piping: Stainless steel body, material type to match piping material as specified in Section 15060.
- d. Ball: Type 304 or 316 stainless steel.
- e. Seats: PTFE.
- f. Stem seals: PTFE or Viton.

- g. Bearings: Self-lubricated, corrosion resistant material that will not contaminate potable water.
- h. Valves for combustible fluid applications (digester gas, natural gas, fuel oil, etc.) must be of fire safe design.

#### C. Plastic Ball Valves

##### 1. General:

- a. Type: Non-lubricated and capable of sealing in either flow direction.
- b. End connections: True union; solvent or heat welded to piping.
- c. Operator handle: Lever.

##### 2. Materials:

- a. Body: Polyvinyl chloride (PVC).
- b. Ball: Polyvinyl chloride (PVC).
- c. Seats: PTFE (Teflon).
- d. O-rings: FKM (Viton).

#### D. Manufacturer:

##### 1. Metal Body Ball Valves, Less Than 6-inch:

- a. Apollo Valves as manufactured by Conbraco Industries, Inc.
- b. Metso Automation/Jamesbury.
- c. NIBCO, Inc

##### 2. Plastic Body Ball Valves, Less Than 6-inch:

- a. Asahi America.
- b. Chemtrol Division, NIBCO, Inc.
- c. Plast-O-Matic Valves, Inc., or
- d. Approved equal.

### **2.07 Swing Check Valves**

- A. Swing check valves shall be lever and weight type unless specifically noted otherwise on the plans or for piping system. Disc, disc arm, shaft, keyways, lever and spring shall be capable of closing within .05 seconds of pump stoppage and fluid moving at velocity of 8 feet per second. Spring tension shall be adjustable. The valve design shall permit mounting levers and springs on either side of the valve body.
- B. Valves shall be provided with a clear opening equal to or greater than the connecting piping, with no raised seating surface. Seats shall be threaded onto the body or fitted with an O ring seal and locked in place with 316 stainless steel screws or pins and shall be replaceable. Shafts shall be provided with stuffing box and packing or O ring seals at each end which are externally replaceable. Valves shall be designed for continuous use in raw wastewater service.
- C. Check Valves shall be constructed to permit top entry for complete removal of internal components without removing the valve from the line.
- D. Markings shall be in accordance with AWWA C-508 and shall include size, working pressure, and cast arrow to indicate direction of flow, name of manufacturer, and year of manufacture.

E. Check Valves (2” through 12”) shall be rated at 200 psi water working pressure, 400 psi hydrostatic test for structural soundness. Check valves (14” through 36”) shall be rated at 150 psi water working pressure, 300 psi hydrostatic test. Production testing shall be done in accordance with AWWA C508.

F. Unless otherwise specified, valves shall, as a minimum, conform to the following pressure ratings:

Valve Size, inches	Working Pressure, psig	Hydrostatic Test Pressure, psig
2 - 12	200	400
14 - 36	150	300

G. Valves 1/4 inch through 3 inch:

1. 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.

2. Materials:

- a. Body, cap, hinge, and disc: Bronze.

H. Valves 4 inch through 24 inch:

1. Valve design:

- a. In accordance with AWWA C508.
- b. Constructed to permit top entry and removal of internal components without removing the valve.
- c. Equipped with outside lever and weight.

2. Materials

- a. Check Valves shall be constructed of heavy ductile iron body with a bronze seat ring, bronze mounted, full opening swing type. The Seat Ring shall be locked in place with stainless steel lock screws and be replaceable without special tools. Valve clapper shall swing full open permitting a “full flow” thru the valve equal to the nominal pipe diameter. They shall comply with AWWA Standard C-508 latest revision.

Components	Material
Body/Cover	Ductile Iron, A536 GR. 65-45-12
Resilient Disc Clapper	Disc Clapper to be Ductile Iron, Rubber faced (Buna N).
Seat Rings	Stainless Steel, Type 316
Hinge shafts, hinge pins and spring	Stainless Steel, ASTM 276, Type 316
Shaft bushings	Bronze, AWWA C508
Coating	Fusion Bonded Epoxy

3. Manufacturers:

- a. GA Industries Figure 340 Ludlow Swing Check Valve, Crispin SWL-LW, or approved equal.

**2.08 Modulating Pinch Valves (MOV220, MOV230, MOV331, MOV332)**

- A. Modulating pinch valve shall consist of the valve body, elastomer sleeve liner, pinch bars, pull bars, actuator shaft, actuator base plate or yoke, actuator and assembly hardware. The Valves shall be opened and closed with two mechanical pinch bars that constrict the elastomer sleeve liner between the bars. The pinch bars shall be enclosed inside the valve body. The top pinch bar shall be raised and lowered by a center actuator shaft. The lower pinch bar shall be raised and lowered with two pull bars anchored to the actuator base plate or yoke.
- B. See Section 15145 – Electric Actuators for specification requirements for the electric actuator.
- C. Valves shall provide 100 percent of the port area of the joining pipe at the valve ends and, unless otherwise specified, through the entire length of the valve. Valves shall be capable of closing bubble tight against the maximum pressure.
- D. Modulating pinch valve shall be enclosed, split body design. All valves shall have flanged ends compatible with connecting piping. Flanges diameter and drilling shall conform to ANSI B16.1, Class 125. Flanges shall be finished to true plane surfaces within a tolerance limit of 0.005 inch. The finished face shall be normal to the longitudinal valve axis within a maximum angular variation tolerance of 0.002 inch per foot of flange diameter.
- E. Pinch valves shall be equipped with a one piece, seamless flange-to-flange elastomer sleeve liner specifically designed for the specified service conditions. The elastomer sleeve shall be compression molded or hand wrapped and reinforced with polyester cord ply. Pull tabs attached to the cord ply and extending through the exterior elastomer coating shall be furnished for attachment to the pinch bars to ensure positive opening force under negative pipeline pressure.
- F. Unless otherwise specified, the actual length of valves shall be within plus or minus 1/16 inch of the specified or theoretical length.
- G. All ferrous metal surfaces of valves and accessories, both interior and exterior, shall be shop coated for corrosion protection. The valve manufacturer’s standard coating will be acceptable, provided it is functionally equivalent to the specified coating.

Surface to be Coated	Coating Material
Unfinished Surfaces (liquid service)	Epoxy Enamel
Exterior Surfaces of Valves	Asphalt varnish or coal tar epoxy
Polished or Machined Surfaces	Rust-preventative compound
Actuator and Accessories	Universal primer

H. Material of construction shall be:

Components	Material
Rating	Class 125
Body	ASTM A48, Cast Iron
Elastomer Sleeve Liner	Buna-N with polyester reinforcing cord ply

Pull and Pinch Bars	Ductile Iron or carbon steel when enclosed. Stainless steel, AISI Type 316 when exposed.
Stem and Guide Rods	Stainless steel, AISI Type 316
Assembly Hardware	Stainless steel, AISI Type 316
End Connection	Flanged, ASME B16.1, Class 125, flat faced
Valve Operator	Manual with handwheel
Manufacturers	Red Valve "Series 5200E"

## 2.09 Telescoping Valve (MOV-631 & MOV-641)

- A. Telescoping valve shall be suitable for working with liquids of low and high concentration of solids.
- B. The valve shall be electrically actuated with non-rising stem and have floor mounted bracket.
- C. The telescoping valve shall be fitted with a 12" scum baffle made of 316 stainless steel.
- D. Stainless steel or steel tubes up to 24" size shall be manufactured from seamless pipe or tube. Tube lengths shall be as shown or noted on the drawings and must be of sufficient length to facilitate valve travel and maintain an appropriate insert depth. Valve tubes are to be a minimum 1/8" thick and are attached to connecting stems by use of a lifting bail.
- E. A cast iron or stainless steel companion flange and Buna-N slip seal gasket shall be provided. The gasket must be a minimum 1/4" thick. The inside diameter of the gasket is to be 1/8" smaller than the outside diameter of the valve tube to provide a friction seal. The gasket is to be sandwiched between the riser pipe flange and the companion flange. The gasket and companion flange shall include a 125# standard drilling pattern to match the riser pipe.
- F. The bail shall be the same material as the tube and be rigidly welded to the tube.
- G. The operator shall be a rising stem style with an electric actuated operator, a linear position indicator, calibrated in 1/4" increments, incorporated in the stainless steel floor stand. A stainless steel traveling torque tube and stainless steel anti-rotation plate shall be incorporated to prevent the slip tube from rotating. The floor stand shall be stainless steel with stainless steel top and bottom mounting plates prepped for actuators. All fasteners shall be 304 stainless steel.
- H. Materials of construction shall be as follows:

Components	Material
Body	AISI 316 Stainless Steel
Seat Sealing	BUNA-N
Flange	ASTM A36/AISI 316
Bolts and Nuts	AISI 316
Extension	AISI 316
Pedestal	AISI 316
Drive	Electric Actuator 480VA/3Ph & Space Heater
Drive Stem	AISI 316
Slip Tube Type	Square

Scum Baffle	AISI 316
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**2.10 Tank Wall Hydrostatic Pressure Relief Valve**

- A. Valves shall be designed for relief of hydrostatic pressure on the secondary clarifier through the walls.
- B. The relief valves shall have a 316-stainless steel body, cover, and removable grate/strainer in the vane. Valves with a removable strainer in the wall shall not be acceptable.
- C. The cover shall have a resilient seat which mates with a machined stainless-steel surface for sealing. Rubber-to-rubber seals shall not be acceptable.
- D. The body of the wall pipe shall have an integrally cast water stop to prevent water from traveling around the outside of the wall pipe.
- E. Wall pipes shall be supplied to the exact length required to avoid field cutting.
- F. Valve shall be Trumbull Manufacturing 367-1560, 4" or equal approved by the Engineer.
- G. Materials of construction shall be as follows:

Components	Material
<b><u>Resilient Seat Wall Relief Valve</u></b>	
Body	ANSI 316 Stainless Steel
Seat Sealing	Buna-N
Grate/Strainer	ANSI 316 Stainless Steel
Hing & Cotter Pins	Stainless Steel
Disc & Lock Washer	ANSI 316 Stainless Steel
Disc	ANSI 316 Stainless Steel
Flange	ANSI 125
Bolts and Nuts	ANSI 316 Stainless Steel
<b><u>Wall Thimble</u></b>	
Body	Ductile Iron
Flange	ANSI 125#
Coating	Tnemec N140-1211 Epoxy

- H. The valves shall be installed with a crushed stone drain applied to the external entry to the valve. A minimum of 1 cubic yard of crushed stone should be used per port.
- I. The valves shall be installed according to manufacturer's recommendations.

**2.11 Air Vacuum / Air Relief Valve or Combination Air Valves**

- A. Valves shall be designed for sewage service and equipped with non slam attachments.
- B. Automatic combination air release valves shall be float operated, rolling seal, or simple lever type designed to automatically exhaust air from piping under pressure and during filling and allow air to enter pipeline during draining. Automatic exhaust and intake of large quantities of air during filling

and draining of pipelines, respectively, and release of accumulated air while pipeline is under pressure.

- C. The air vent shall close drip tight, incorporating an easily renewable Buna-N seat or reinforced nylon/EPDM rolling seat.
- D. The valve shall have a conical shaped body with a cam lock back flush attachment.
- E. Internal parts removable through top cover without removing valve from pipeline.
- F. Pressure rating: 150 pounds per square inch.
- G. Materials of construction shall be as follows:

Components	Material
Body	316 Stainless Steel
Roll Seal	Buna – N
Float	316 Stainless Steel
Stem	316 Stainless Steel
Upper Float	Polypropylene

- H. Manufacturers/Models: ARI D020 equipped with non slam attachments, no equal.

**2.12 Miscellaneous Valves and Components**

A. Valve Boxes:

1. Provide 9” inside diameter precast, traffic rated, type G5 valve boxes with bolt down cast iron covers by Christy Concrete Products, Jensen Precast, or equal
2. Valve boxes outside of street or traffic locations shall be installed with a 12-inch wide by 6-inch deep concrete collar with a #4 rebar reinforcing ring.
3. All valve box lids shall be marked for Reclaimed Water or Potable Water to match service.
4. Operator nut shall be within 40-inches of final surface grade.
5. All gate valves shall be centered in a one-piece riser stock with the use of a riser aligner or equal.

**2.13 Pressure/ Vacuum Gauges**

- A. Pressure Gauges: Gauges shall be mounted on diaphragm seals. All gauges shall have internal or external pulsation dampeners or snubbers. Gauges shall be 4-inch premium grade, glycerin filled units of the bourdon tube element type. They shall have 270-degree milled stainless steel movements, phenolic cases, shatterproof glass windows, and 1/2-inch NPT process connections. Uncertainty shall be no greater than 1 percent of span. All exposed metal parts shall be 300 series stainless steel.
- B. Diaphragm Seals: Diaphragm type chemical seals shall consist of a 316 stainless steel body with the diaphragm material to be determined by the manufacturer for the specific application. Seals shall be of the thread attached type and shall be provided with a purge connection.
- C. Pressure Sensors (Tubular Chemical Seals): Pressure sensors (tubular chemical seals) shall be of the full line-size type with an ANSI flanged or wafer type cast iron or steel body and flexible liner suitable for the service intended. A liquid filled cavity between the liner and the body shall

transmit the line pressure to a diaphragm seal attached by a threaded nipple. The sensing medium shall be equal parts of ethylene glycol and water and shall be factory installed.

- D. Gauge Taps: Unless otherwise shown or specified, gauge taps shall be provided on the suction and discharge of all pumps having inlet and outlet piping larger than 2 inches in diameter and on the suction and discharge of all vacuum pumps, and air and gas blowers. All gauge taps shall consist of 1/4-inch gauge cock attached by a threaded nipple to the pipeline. The exposed threads of each gauge cock shall be protected by a brass plug.
- E. Vacuum Range: Suction gauges shall register vacuum range from -34 to +34 feet of water.

## **2.14 Valve Operators**

- A. All valves, except check valves, shall be provided with manual operators unless otherwise specified. The direction of rotation of the handwheel or lever to open the valve shall be counterclockwise. Each valve body shall have cast thereon the word OPEN and an arrow indicating the direction to open.
- B. Manual valve operators shall meet the requirements of Section 15000 - Piping Material and Components.

## **2.15 Valve Boxes**

- A. Valve boxes extending to the finished or established ground or paved surfaces shall be provided for all buried valves.
  - 1. Valve boxes shall be H-20 traffic rated. Valve boxes shall be Christy G5 and Christy C275 with cast iron ring and cover labeled, or equal.
- B. Valve boxes outside of street or traffic locations shall be installed with a 8-inch wide by 6-inch deep concrete collar with a #4 rebar reinforcing ring.
- C. All valve box lids shall be marked for Potable Water, Sewer, and Reclaimed Water to match service, unless otherwise stated on the Plans.
- D. Operator nut shall be within 30-inches of final surface grade.
- E. All gate valves shall be centered in a one-piece riser stock with the use of a riser aligner or approved equal.
- F. Covers shall be of the screw or sliding type having 5-1/4 inch shaft diameter or greater. All cast iron parts shall be coated by dipping a hot bituminous varnish.
- G. They shall have suitable base castings to fit properly over the bonnets of their respective valves and heavy top sections with stay-put covers.
  - 1. Bolt downs shall be used in high traffic areas.

## **2.16 Quick Disconnects**

- A. Quick disconnects shall not be disconnectable under pressure.
- B. Quick disconnects for air service shall be 1/2 inch, unless otherwise noted.
- C. Quick disconnects for water service shall be 1 inch size, unless otherwise specified or shown.

## **2.17 Service Saddles**

- A. The saddle shall meet all applicable AWWA C800 standards and shall be NSF 61 listed.
- B. The saddle shall have an outlet for the service connection that will allow an NPT or AWWA thread to be tapped into it, in sizes from 5/8" through 4", depending on the saddle body size.

C. The saddles shall be provided with the following connections

**Size**

3 1/2" and smaller sizes

Above 3 1/2":

**Connection**

two 1 1/2" bales with inserted straps

2 straps 1 1/2" wide

D. The gasket shall be fully entrapped in the saddle body to hold it in place.

**PART 3 - EXECUTION**

**3.01 Installation**

A. General:

1. Valves shall be installed in accordance with the manufacturer's instructions.
2. Valves shall be independently supported to prevent stress on pipe.

B. Access:

1. Valves shall be installed to provide easy access for operation, removal and maintenance and to prevent interferences between the valve operators and structural members or other obstructions.

**\*\*END OF SECTION\*\***

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# SECTION 15140 VALVE AND GATE OPERATORS

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: The work of this Section includes furnishing and installing all shut off and throttling valves with manual and power operators as indicated. The Contractor shall provide the valve operators, complete and operable, including all controls, motors, gears, enclosures and other necessary appurtenances as indicated. The work also requires that the valve manufacturer accept responsibility for furnishing the work in this Section but without altering or modifying the Contractor's responsibilities under the Contract Documents.

### 1.02 References

- A. Except as otherwise indicated, the current editions of the following apply to the work of this Section:

<u>Reference</u>	<u>Title</u>
JIC P-1	Pneumatic Standards for Industrial Equipment and General Purpose Machine Tools
NEMA ICS-2	Industrial Control Devices, Controllers and Assemblies

### 1.03 Submittals

- A. The Contractor shall provide the following submittals, in accordance with Section 01330 – Submittals, in addition to the submittals required by Section 11010 – General Requirements for Equipment with the Submittal for the associated valve and gates.
1. Shop drawings for each unit.
  2. Outline installation drawings for each unit.
  3. Material list and catalog information showing the details of construction.
  4. Product data, materials, electrical wiring and control diagrams.
- B. Operation and Maintenance Data: Installation, operating and maintenance data in accordance with Section 01360 - Operating and Maintenance Information.
- C. List(s) of recommended Spare Parts and Special Tools

### 1.04 Services of Manufacturer

- A. Inspection, Startup, and Field Adjustment: An authorized representative of the manufacturer shall visit the site to inspect the installation, start up the equipment, and make field adjustments as necessary. The authorized service representative shall also instruct the Owner's personnel in the operation and maintenance of the equipment.

## PART 2 - PRODUCTS

### 2.01 General

- A. Only products certified as complying with the indicated requirements shall be provided. For all electric motor operators, the Contractor shall assign the valve manufacturer the responsibility of any field adjustments to set the operator limit switches for the required function. The Contractor shall include the cost of this service in the bid. All wires of motor operators shall be identified with a unique number.

**2.02 Electric Motor Operators (AC Reversing Control Type)**

- A. See Section 15145 – Electric Actuators

**2.03 Electric Motor Operators (Positioning Service)**

- A. See Section 15145 – Electric Actuators

**2.04 Pneumatic Operators**

- A. Not used

**2.05 Manual Operators**

- A. All valves and gates, except check valves, shall be provided with manual operators unless otherwise specified. The operator shall be either levers or handwheels opened in the counterclockwise direction, unless otherwise indicated. Each valve body shall have cast thereon the word OPEN and an arrow indicating the direction to open.
- B. Where buried, the valves shall have extensions with square nuts or floor stands. Valves mounted higher than 6 feet above floor or operating level shall have chain operators.
- C. Unless otherwise indicated, valves of sizes 4-inch and larger shall have gear-assisted operators.
- D. Geared buried plug valves shall have a position indicator installed at top of extension.

**PART 3 - EXECUTION**

**3.01 Installation**

- A. Products and equipment shall be installed in accordance with the manufacturer's written installation instructions.

**3.02 Field Testing**

- A. Products shall be field-tested for compliance with the indicated requirements.

**\*\*END OF SECTION\*\***

# SECTION 15145 ELECTRIC ACTUATORS

## PART 1 - GENERAL

### 1.01 Summary

A. Section includes: Electric motor-driven actuators for valves.

### 1.02 References

A. Except as otherwise indicated, the current editions of the following apply to the work of this Section:

AWWA C504	Standard for Rubber-Seated Butterfly Valves.
AWWA C540	Standard for Power-Actuating Devices for Valves and Slide Gates.
NEMA 250	Enclosures for Electrical Equipment (1000 V Maximum).

### 1.03 Submittals

A. Clearly identify any exceptions in terms of quantities and/or quality of actuator(s) being submitted.

B. Product data:

1. Electrical ratings:
  - 1) Voltage and number of phases.
  - 2) Horsepower.
  - 3) Voltage levels and source for control and status.
2. Description of integral control interface.
3. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
4. Gear ratios for both manual and motorized actuation.
5. Opening and closing directions.
6. Allowable starts per hour.
7. List of all included options and accessories.
8. Full travel times.
9. Gearbox data including gear ratio, and gearbox efficiency.

C. Shop Drawings:

1. Wiring diagrams:
  - 1) Include all options and expansion cards furnished with each actuator.
2. Dimensioned drawings of each valve and actuator combinations.
3. Dimensioned drawings of each valve gearbox.
4. Electric motor data.

D. Manufacturer's instructions:

1. Include manufacturer's instructions, description of system operation, start-up data, and troubleshooting checklist. If a full manual is submitted, instead of the subset of relevant pages

as required to fully describe the component, instrument or other, all irrelevant information shall be "X'd" out.

E. Operations and maintenance data:

1. Include manufacturer's literature; cleaning procedures, replacement part lists, wiring diagrams, and repair data.
2. Included a list of all configurable parameters, and the final values for each.
3. List of recommended spare parts.
4. List of special tools necessary for proper operation and/or maintenance.
5. Exploded view drawings that illustrate all assemblies, sub-assemblies, and components.
6. Routine test procedures for all electronic and electrical circuits.
7. Troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.
8. Certified factory and field-test results.

**1.04 Quality Assurance**

A. Obtain required information from the valve/gate supplier, including but not limited to:

1. Interface to gate or valve.
2. Operating range (in degrees).
3. Quarter turn or multi-turn.
4. Required turns for full travel on multi-turn applications.
5. Direction of rotation for opening and closing.
6. Maximum and normal torque requirements.

B. All motorized, intelligent actuators shall be the product of a single manufacturer for all valve and gate applications on this project, regardless of gate or valve type, manufacturer, or supplier.

**PART 2 - PRODUCTS**

**2.01 General**

- A. Manufacturers: Reversing and positioning control valve operators shall be manufactured by Rotork, AUMA, no equal.
- B. Electric type operators shall include the motor, operator unit gearing, limit switches, torque switches, declutch lever, auxiliary handwheel for operation in case of power failure, reversing starter, switches, mechanical position indicator, and accessories deemed necessary by the vendor.
- C. The valve actuator motor and all electrical enclosures shall be weatherproof, NEMA 4, as a minimum unless explosion-proof is indicated on the drawings.
- D. The power gearing shall consist of helical gears of heat-treated steel, and worm gearing of hardened alloy steel.
- E. The responsibility for proper operation shall reside with the valve supplier.
- F. Motors shall be adequately sized to operate the valve at the differential pressure for each valve location. The motor shall be of sufficient size to open or close a valve against the maximum

specified differential pressure when voltage to the motor is  $\pm 10\%$  of nominal voltage. Motor rating shall be for continuous duty.

## 2.02 Characteristics for Actuators

- A. Provide actuators complete and operable with all components and accessories required for operation.
- B. Power supply:
  - 1. Voltage, phase & frequency shall be 480V/3/60, or as scheduled in the drawings.
  - 2. Valve or gate motion independent of power supply phase rotation.
  - 3. Provide an internal backup power source to maintain settings and track valve position when main power is off.
  - 4. The actuators shall incorporate all major components such as the motor, starter, local controls, terminal etc. housed within a self-contained, sealed enclosure.
- C. Control interface:
  - 1. Configuration:
    - 1) Provide a non-intrusive, non-contacting interface for configuring all input and output settings, control values, ranges, torque switch settings, valve positions switch settings, and options:
      - a) Configure form a hand-held configuring tool or input devices on the actuator.
  - 2. Local interface, integral to actuator:
    - 1) Non-intrusive, non-contacting selector switches:
      - a) LOCAL-STOP-REMOTE:
        - i) Motor actuator operation is prevented with the switch in STOP.
      - b) OPEN-CLOSE:
        - i) Controls the valve when LOCAL-STOP-REMOTE is in LOCAL.
        - ii) Spring return to center.
        - iii) Configurable between maintained (actuator runs until end of travel, high torque, or a LOCAL-STOP-REMOTE is switched to STOP) and momentary (actuator stops when switch is released).
    - 2) Local controls:
      - a) Shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.
      - b) Shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.
    - 3) Local display:
      - a) Valve fully open and fully closed indicators.
      - b) Numerical display showing actual valve or gate position in percent of travel.
  - 3. Control inputs:
    - 1) Controls the valve when LOCAL-STOP-REMOTE is in REMOTE.

- 2) Isolated inputs capable of operating from external control voltage source or internal power supply:
    - a) Furnish 120 VAC and 24 VDC control power supplies within the actuator.
  - 3) Provide for the following dry-contact inputs from the SCADA system:
    - a) OPEN
    - b) CLOSE.
  - 4) STOP, OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a STOP input) and momentary (actuator stops when command is removed).
4. Status outputs:
- 1) In Local.
  - 2) In Remote.
  - 3) Actuator Fault.
  - 4) All output contacts rated for 5 amps, 120 VAC and 24 VDC.
5. Analog input (for modulating valves):
- 1) Provide a 4-20 milliampere analog input for analog modulating valves when indicated on the Drawings.
  - 2) Modulate valve to maintain position based on analog input value.
  - 3) Maximum input impedance 250 ohms.
6. Analog output (for modulating valves):
- 1) Provide an isolated 4-20 milliampere analog output when indicated on the Drawings:
    - a) Loop power sourced from the actuator power supply.
    - b) Capable of driving into a load up to 500 ohms.
    - c) Output proportional to process value(s) indicated on the Drawings.
    - d) Valve or gate position.

D. Features:

1. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.
2. Data logging:
  - 1) Store diagnostic data and reference data.
  - 2) Time-stamped historical operating data, including number of operations and most recent operations.
  - 3) Torque profiles showing actual torque at each valve position through the operating range Starting torque, maximum running torque, and end of travel torque:
    - a) Store reference data (recorded during commissioning) and data from last operation.
3. Provide display of logged data on the actuator, or provisions to download to a personal computer.

E. Materials:

1. Construct motorized actuators of materials suitable for the environment in which the valve or gate is to be installed.

F. Components:

1. Motors.
2. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
3. Torque ratings equal to or greater than that required for valve seating and dynamic torques.
4. Capable of being removed and replaced without draining the actuator gear case.
5. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
6. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius:
  - 1) Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
  - 2) 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
7. Provide the following motor protection features:
  - 1) Stall – de-energize the motor within 8 seconds in the event of a stall when attempting to unseat a jammed valve.
  - 2) High motor temperature (sensed by an embedded thermostat).
  - 3) Single phasing – lost phase protection.
  - 4) Direction – phase rotation correction.

G. Enclosures:

1. Stainless steel external fasteners.
2. Provide 'O' ring seals for each of the following areas:
  - 1) Between the terminal compartment and the internal electrical elements.
  - 2) Between the mechanical and electrical portions to protect from the ingress of oil, and to protect the mechanical components of oil from dust and moisture when the electrical terminal is open.
3. Provide the following minimum enclosure ratings:
  - 1) NEMA Type 4 enclosure for general applications.
4. Provide UV protective clip-in display cover for actuators installed outdoors.

H. Position sensing:

1. Electronic and adjustable using a solid-state encoder wheel:
  - 1) Mechanical limit switches and potentiometers are not acceptable.
2. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.
3. Valve range and position switch outputs field adjustable.

I. Manual actuators:

1. Hand wheel for manual operation:
    - 1) Maximum 80 pound pull on rim when operating gate or valve under maximum load.
    - 2) Clockwise operation to close valve.
  2. Declutch lever: Padlockable, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.
- J. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set:
1. Accurately cut to assure minimum backlash.
- K. Bearings:
1. Anti-friction bearing with caged balls or rollers throughout.
  2. Sealed-for-life type thrust bearings housed in a separate thrust base.
- L. Drive bushing:
1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
  2. Positioned in a detachable base of the actuator.
- M. Lubrication:
1. Provide totally enclosed actuator gearing with oil filled gear case suitable for operation at any angle.
  2. Suitable for standard SAE80EP gear oil.
  3. Actuators requiring special or exotic lubricants are not acceptable.

## **2.03 Accessories**

- A. Software:
1. Furnish PC-based diagnostic and configuration software to display diagnostic data and configure actuators.
  2. Provide software communications to the valve actuator and hand-held setting tool using Bluetooth wireless or IrDA infrared communications:
- B. Setting tool:
1. If required for setting or configuring the actuator, provide a hand-held setting tool:
    - 1) Furnish 1 setting tool.
    - 2) Capable of communicating with PC-based configuration software, and transferring the following in either direction between the computer and programmer and setting tool, and between the setting tool and actuator.
    - 3) Actuator configurations:
      - a) Capable of storing up to 10 different configurations.
    - 4) Diagnostic data:
      - a) Capable of storing 4 complete sets of diagnostic data.
- C. Remote hand station:
1. Where indicated on the drawings, provide a remote hand station (Rotork - RHS) for the actuator.
  2. NEMA Type 4 enclosure.

## **PART 3 - EXECUTION**

### **3.01 Installation**

A. Install actuators in accordance with manufacturer's instructions.

### **3.02 Manufacturers Field Services**

A. Inspection, Startup, and Field Adjustment: An authorized representative of the manufacturer shall visit the site to inspect the installation, start up the equipment, and make field adjustments as necessary. The authorized service representative shall also instruct the District's personnel in the operation and maintenance of the equipment.

**\*\*END OF SECTION\*\***

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## **SECTION 15190 MECHANICAL IDENTIFICATION**

### **PART 1 - GENERAL**

#### **1.01 Summary**

A. This section includes materials and installation of mechanical systems identification.

#### **1.02 Submittals**

A. Submit manufacturer's technical product data and installation instructions for each identification material and device required in accordance with Section 01330 – Submittals.

B. Schedules:

1. Submit valve schedule for each piping system,
  - a. Typewritten and reproduced on 8-1/2- by 11-inch bond paper.
  - b. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any), column indicating if mechanical device is intended for emergency shutoff and similar special uses.
  - c. In addition to mounted copies, furnish extra copies for maintenance manuals.

#### **1.03 Quality Assurance**

1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices, unless otherwise indicated.

### **PART 2 - PRODUCTS**

#### **2.01 Mechanical Identification Materials**

A. Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 sections. Where more than a single type is specified for application, provide single selection for each product category.

B. Manufacturers:

1. Allen Systems, Inc., W. H. Brady Co., Signmark Division, Industrial Safety Supply Co., Inc., Seton Name Plate Corporation, or approved equal.

#### **2.02 Plastic Pipe Markers**

A. Provide pipe markers as specified in Section 15055 – Piping Materials and Components.

#### **2.03 Plastic Duct Markers**

A. Manufacturer's standard laminated plastic, color-coded duct markers. Supply separate color codes for supply, exhaust, outside, and return air.

B. Include the following nomenclature:

1. Direction of air flow.

2. Duct service (supply, return, exhaust, outdoor air)

#### **2.04 Valve Tags**

##### A. Brass Valve Tags:

1. Polished brass valve tags with stamp-engraved piping system abbreviation in ¼-inch high letters and sequenced valve numbers 1/2 inch high, and with hole for fastener.
2. 1-1/2-inch diameter tags, except as otherwise indicated.

##### B. Valve Tag Fasteners:

1. Solid brass chain (wire link or beaded type), or solid brass S-hooks.

##### C. Access Panel Markers:

1. Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve.
2. Include center hole to allow attachment.

#### **2.05 Engraved Plastic-Laminate Signs**

##### A. Engraving stock melamine plastic laminate, Federal Specification L-P-387, in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

##### B. Thickness:

1. 1/16 inch for units up to 20 sq.in. or 8 inches in length; 1/8 inch for larger units.

##### C. Fasteners:

1. Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

#### **2.06 Plastic Equipment Markers**

##### A. Manufacturer's standard laminated plastic, color-coded equipment markers. Conform to the following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.

##### B. Nomenclature:

1. Match terminology used on drawing schedules as closely as possible.

##### C. Size:

1. Provide approximate 2-1/2- by 4-inch markers for control devices, dampers, and valves; and
2. 4-1/2- by 6-inch markers for equipment.

#### **2.07 Lettering and Graphics**

##### A. Coordinate names, abbreviations and other designations used in mechanical identification work with corresponding designations shown, specified or scheduled.

##### B. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of mechanical systems and equipment.

- C. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples: Chiller No. 3, Air Handling Unit No. 42, Standpipe F12, and the like).

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

### **3.02 Ductwork Identification**

- A. Identify air supply, return, exhaust, and intake ductwork with duct markers, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork identification color).
- B. Location: In each space where ductwork is exposed, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50 foot spacing along exposed runs.
- C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions.
- D. Dampers: Provide 12-inch, plenum-rated marker ribbon to end of all balancing damper handles.

### **3.03 Piping System Identification**

- A. Install pipe markers as specified in Section 15055 – Piping Materials and Components.

### **3.04 Valve Identification**

- A. General: Provide valve tag on every valve, cock and control device in each piping system. Exclude check valves, valves within factory fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibbs, shutoff valves at plumbing fixtures, and similar rough-in connections of end use fixtures. List each tagged valve in valve schedule for each piping system.
- B. Install mounted valve schedule in each mechanical room.

### **3.05 Mechanical Equipment Identification**

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices: Pumps, compressors, chillers, cooling towers and similar motor driven units, electric duct heaters, terminal units, coils, fans, water heaters, blowers, unitary HVAC equipment, tanks and pressure vessels, filters, water treatment systems and similar equipment.

### **3.06 Adjusting and Cleaning**

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts

**\*\*END OF SECTION\*\***

## SECTION 16010 GENERAL ELECTRICAL PROVISIONS

### PART 1 - GENERAL

#### 1.01 Summary

- A. This division includes the provisions for all material, labor, tools, equipment, testing and services necessary to provide a complete and operable electrical system.
- B. The provisions of this Section shall apply to all electrical items specified in the various sections of Division 16 (Electrical), Division 17 (Instrumentation) and all other Divisions specifying electrical items of these Specifications, except where otherwise specified or shown on the Contract Documents.
- C. Furnish all necessary labor, materials, equipment and incidentals required to install a complete and operational electrical system according to the intent of this specification and the accompanying drawings, whether itemized or not.
- D. Examine the specification and drawings for mechanical equipment and provide all starters, circuit breakers, switches, pushbuttons and appurtenances, which are not specified to be with the mechanical equipment. Erect all electrical equipment not definitely stated to be erected by others, furnish and install conduit, wire and cable and make connections required to place all equipment in complete operation.
- E. 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 that is acceptable to the Owner's Representative. Cap conduit runs during construction. Energize all space heaters furnished with equipment.
- F. Interpretation of Drawings:
  - 1. Any error or omissions of detail in either the drawings or the specifications shall not relieve the Contractor from correctly installing all materials necessary for complete and operating electrical system.
  - 2. The Contractor shall inspect the site and verify all measurements and conditions and shall be responsible for the correctness of same. No extra compensation will be allowed because of differences between work shown on the drawings and measurements at the site.
  - 3. The electrical drawings are diagrammatic, but shall be followed as closely as existing conditions and work of other contractors will permit. All deviations from the drawings required to make the work conform to structures as constructed, and to the work of others, shall be made at the Contractor's expense.
  - 4. The Contractor shall examine the architectural, structural, mechanical and manufacturer's drawings for the various equipment in order to determine exact routing and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.
  - 5. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in location of outlets or equipment, prior to roughing in, without incurring any additional costs or charges.
  - 6. Existing Conditions:

- a. The electrical drawings were developed from past record drawings and information supplied by the Owner.
  - b. Carry out any work involving the shutdown of existing services to any piece of equipment now functioning or the tie-in of equipment to the existing system at such time as to provide the least amount of inconvenience to the Owner. Provide such work when directed by the Owner's Representative.
  - c. After award of Contract, confer with Engineer/Owner's Representative to verify at each area of construction activity the location of existing underground utilities. Protect all existing underground utilities during construction.
  - d. NO work shall be started that involves the existing electrical system without first obtaining and completing all coordination forms required by the facility, city or specifications. All such coordination forms shall be submitted with drawings and procedures showing information about what, where, why and how the work will be done in accordance with the Division 1.
  - e. Prior to starting any underground work the Contractor shall obtain all the information of the underground utilities or obstructions from the Engineer and take proper precautions to locate the utilities by potholing or other approved means in accordance with Special Provisions.
7. Work Provided Outside this Contract:
- a. Incoming high voltage aerial power lines
  - b. Incoming high voltage underground power cables, materials, installation, termination, and connection. Under this Contract, provide trench, and backfill, and conduit to Owner supplied service point.
  - c. Transformers supplying main electrical service to the facility.
  - d. Power Company metering facilities, except as indicated.
  - e. Incoming telephone service
  - f. Interior telephone system, outlet and junction boxes, cover plates, pull wires

#### G. Substitutions

- 1. The contract documents were developed using the first named manufacturer to determine physical space requirements, conduit and wiring requirements, capacities/ratings and implementation of the contract electrical and instrumentation control strategies. When indicated in the contract documents, the contractor may elect to use one of the other named manufacturers, or where allowed, provide equivalent previously unnamed manufacturers. Any deviations from the contract documents that result from using a manufacturer other than the first named manufacturer are the responsibility of the contractor.
- 2. Specific brand names and catalog numbers are used to describe materials in order to establish standards of performance and quality.
- 3. The decision of the Owner's Representative shall govern as to what is equal to the item specified. Equality will be judged on the basis of the following:
  - a. Conformance with description or performance required
  - b. Equal in quality
  - c. Comparable in appearance and artistic effect where these are considerations
  - d. Comparable operation, maintenance and performance
  - e. Equal in longevity and service under conditions of climate and usage

- f. Conformance with space allocations and requirements for operations from mechanical or electrical services provided without necessitating changes in details and construction or related work
- 4. If the Owner's Representative considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Owner's Representative.
- 5. Any material, article, or method judged by the Owner's Representative equal to that specified will be approved, provided the Contractor submits a single written request to the Owner's Representative, per Special Provisions Section, with the following information for each item:
  - a. Name of manufacturer or supplier
  - b. Trade or brand name
  - c. Type, model, style, and/or catalog number
  - d. Size or capacity rating
- 6. The Contractor assumes full responsibility for including complete, correct data in this one request and shall also attach completely referenced diagrams descriptive and technical data sheets for the Owner's Representative's determination of equality or suitability of appearance of any substitution item. Only one such request may be submitted. The Owner's Representative's rejection of any substitute shall automatically require the Contractor to furnish the specified item without further discussion or delay.

## 1.02 REFERENCES

- A. Electrical work, including connection to electrical equipment integral with mechanical equipment described elsewhere in these specifications, shall be performed in accordance with the latest published regulations of the following codes and standards:

<u>Reference</u>	<u>Title</u>
	Federal Standards
	State Codes and Ordinances and Inspecting Authorities
	Local Codes and Ordinances and Inspecting Authorities
	The National Board of Fire Underwriters
NFPA	National Fire Protection Association
UL	Underwriters Laboratories
NEMA	National Electrical Manufacturers' Association
ANSI	American National Standards Institute
IEEE	Institute of Electrical and Electronic Engineers
IPCEA	Insulated Power Cable Engineers Association
OSHA	State Department of Industrial Safety
	State Public Utilities Commission
NEC	National Electrical Code (NEC) for all items not specifically covered the state and local ordinance.
NFPA 79	Electrical Standard for Industrial Machinery
NFPA 820	Standard for Fire Protection in Wastewater Treatment and Collection

**Reference**

**Title**  
Facilities.

- B. Nothing in these special provisions or on the drawings shall be interpreted as permission or direction to violate any governing code or ordinance.
- C. Materials and equipment used in the performance of the electrical construction shall be fully UL approved for the class of service for which they are intended prior to submittal of shop drawings.
- D. Without limiting the generality of other requirements of these specifications, all work specified herein shall conform to or exceed the applicable requirements of the National Electric Code (NEC); provided, that where a local code or ordinance is in conflict with the NEC, the provisions of said local code ordinance shall take precedence.
- E. The construction and installation of all electrical equipment and materials shall comply with all applicable provisions of the Cal OSHA Safety orders (Title 8, CCR), State Building Standards, and applicable local codes and regulations

**1.03 System Description**

- A. The general extent of the electrical work includes, among others, the furnishing and installing of the following items:
  - 1. Complete circuiting and connections for all motors, including their remote control and indicating devices
  - 2. Complete general lighting and small power installation, fixtures, receptacle outlets, switching and circuits
  - 3. All supports, bases, anchors, sleeves, hangers, conduit seals, and the like, all electrical work shown and/or specified, not particularly mentioned above
  - 4. Complete grounding systems
  - 5. Instruction, maintenance and overhaul manuals
  - 6. Control and alarm wiring
  - 7. Coordination for connection of power with utility company
  - 8. Utility Company Metering
  - 9. Utility Services including all charges
  - 10. Electrical Service Equipment
  - 11. Main Switchboard
  - 12. Motor Control Center
  - 13. Surge Protective Devices
  - 14. Panelboards
  - 15. Transformers – Dry Type
  - 16. Standby Generator System
  - 17. Stationary Load Bank
  - 18. Automatic Transfer Switch
  - 19. Variable Frequency Drives and VFD programming

20. Power Monitor and power monitor programming
  21. Uninterruptible Power Supply
  22. Control Panel
  23. Installation of vendor supplied panels
  24. Installation of conduit and conductors between vendor supplied field equipment and vendor supplied panels including termination of conductors within the vendor-supplied panels based on vendor-supplied documentation
  25. Conduit, wire, cable terminations, and equipment mounting associated with the Instrumentation System
  26. Interconnection wiring diagrams
  27. Hardware and software at the facility to allow the facility to transmit and receive data, alarms and commands from the new SCADA system.
  28. Programmable controller
  29. Operator Interface Terminal
  30. Conduit, wire, cable, terminations and equipment mounting associated with the telemetry
  31. Power, control, alarm and instrumentation wiring for all equipment specified in specification Divisions 11, 15, 16, and 17
  32. Electrical connections to all Mechanical equipment and instruments
  33. Electrical Tests
- B. Manufacturer's Directions: Manufacturer's directions shall be followed in all cases where manufacturers furnish instructions covering points not shown on the drawings or herein specified.
- C. Service for Electrical Power
1. Coordinate with utility company for a new incoming electrical service 480 volt, three phase, four wire service to site as shown on drawings with the Owner.

#### **1.04 Submittals**

- A. General: Submittals for all electrical equipment provided under this project manual shall be prepared and submitted within 60 days after notice to proceed.
- B. Materials and Equipment Schedules: The Contractor shall deliver to the Engineer a complete list of all materials, equipment, apparatus, and fixtures which it proposes to use. The list shall include sizes, names of manufacturers, catalog numbers, and such other information required to identify the items.
- C. The submittal package for each individual equipment or groups of related equipment shall be complete and in accordance with this Section. As a condition precedent to the review of submittals and with the requirements of Special Provisions, the Contractor shall furnish the manufacturer's statements accepting unit responsibility. The purpose of this provision is to ensure compatibility of all components specified under the specific technical specification and to provide sole source responsibility for system performance and maintenance. Notwithstanding these provisions, however, the Contractor is not relieved of his responsibility for the indicated portions of the work. The following, as a minimum, shall be submitted:
1. Manufacturer and manufacturer's type and designation
  2. Manufacturer's catalog data indicating rated capacity, efficiency, rated output and other characteristics

3. Any exception to these specifications along with justification for each exception shall be clearly stated on the first page of the submittal
  4. Shop drawings
  5. Parts list with material of construction
  6. Installation requirements, showing various clearances required
  7. Details of all appurtenances to be furnished with the specified item
- D. Shop drawings are required for materials and equipment listed in this and other sections. Shop drawings shall provide sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications. The following shall be included:
1. Front, side, and rear elevations, footprints and top views, with dimensions
  2. Location and size of conduit entrances and access plates
  3. Component data
  4. Connection diagrams, terminal diagrams, schematic wiring diagrams, conductor size, and type, etc.
  5. Method of anchoring and embedded structural members; weight
  6. Finish
  7. Nameplates
  8. Temperature limitations, as applicable
  9. Rating of equipment as per specifications and drawings
  10. NEMA rating of enclosures
  11. Approved listing
- E. Catalog data shall be submitted to supplement all shop drawings. Catalog cuts, bulletins, brochures, or the like or photocopies of applicable pages thereof shall be submitted for mass produced, non-custom manufactured material. These catalog data sheets shall be stamped to indicate the project name, applicable Specification section and paragraph, model number, and options. This information shall be marked in spaces designated for such data in the stamp.
- F. Record Drawings: In addition to the Record Drawings as a part of the record drawing requirements specified in the General Requirements, the Contractor shall show depths and routing of all concealed below-grade electrical installations. Said set of record drawings shall be available to the Engineer and the Inspector during construction. After final inspection, the Contractor shall transfer all record drawing information to a set of reproducible vellums which shall then be delivered to the Engineer. In addition, the Record Drawings shall show all variations between the work as actually constructed and as originally shown on the Drawings, based upon information supplied by the Contractor.
- G. Manufacturer's Drawings: One set of equipment manufacturer's drawings shall be submitted to the Engineer for its records.
- H. The Contractor shall obtain and submit from the manufacturer a list of suggested spare parts for each piece of equipment according to the provisions of spare parts of the General Requirements. After approval, Contractor shall furnish such spare parts suitably packaged, identified with the equipment number, and labeled. Contractor shall also furnish the name, address, and telephone number of the nearest distributor for each piece of equipment. All spare parts are intended for use by the Owner, only. Any spare parts which the Engineer permits the Contractor to use for startup

activities shall be replaced by the Contractor prior to the Owner's acceptance of beneficial use of the equipment.

1. During the term of this Contract the Contractor shall notify the Engineer in writing about any manufacturer's modification of the approved spare parts, such as part number, interchangeability, model change or others. If the Engineer determines that the modified parts are no longer applicable to the supplied equipment, the Contractor at its expense shall provide applicable spare parts.

## **1.05 Quality Assurance**

### **A. Performance and Design Requirements**

1. **Manufacturer's Qualifications:** The equipment furnished under this division shall be the product of firms regularly engaged in the design and manufacture of the type of item specified, possessing the required technical competence, skill, resources and ability to complete the work specified herein with the requisite degree of quality in a timely and efficient manner. The Contractor shall be prepared to adequately document the qualifications of the manufacturers nominated to provide the equipment specified under this division. All documentation shall be submitted to the Owner's Representative prior to design fabrication and shipment of any component specified herein. Nothing contained within these provisions shall be construed as relieving the Contractor of his responsibility for any portion of the work covered by this Section.
2. **Arrangement:** The drawings are generally diagrammatic and the location of outlets and equipment terminals are approximate unless detailed or dimensioned. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences and the location of electrical terminations on equipment.
3. The Contractor shall examine the structural and mechanical plans and shop drawings for the various equipment to determine exact routing and final terminations for all raceways and cables. Conduits shall be stubbed up as near as possible to equipment terminals and shall be within the concrete base for the equipment or a separate concrete curb.
4. All conduit and equipment shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Lighting fixtures, switches, convenience outlets, and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, the Contractor shall submit proposed locations to the Engineer for review. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the Owner.
5. All work, including installation, connection, calibration, testing, and adjustment, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.
6. Allowance has been made in the design for the number of raceways, cables and conductors considered adequate for feeding the various drives and equipment. These circuits and diagrams are based on available data pertaining to the particular design of equipment and portray the systems, which the owner has chosen to effect the required operation and level of control. Equipment provided by the Contractor (even though of the make and model specified) may differ in detail, arrangement, or connections from that shown. If the Contractor uses equipment which differs from the equipment shown in major aspects and requires modifications to power, control or other electrical service, the Owner's acceptance of the equipment will be based upon the Contractor providing the modifications required, and they shall be of the same quality as shown and shall be provided at no additional cost to the Owner.

7. Protection of Equipment and Materials: The Contractor shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until acceptable by the Engineer and the Inspector.
8. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
9. The Contractor shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of panels and switchboard sections, at no expense to the Owner.
10. Tests: The Contractor shall make all tests required by the Engineer or the Inspector or other authorities having jurisdictions as per applicable standards.. All such tests shall be performed in the presence of the Engineer or the Inspector. The Contractor shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. Operational testing shall be performed on all equipment furnished and/or connected in other Sections of Division 16. Electrical and all other divisions specifying electrical items including furnishing of support labor for testing.
11. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted to the Engineer and the Inspector for review prior to final acceptance of the project.
12. Any test failure shall be corrected in a manner satisfactory to the Engineer and Inspector.
13. The Contractor shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in these particular specifications or shown on the drawings.
14. The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included under this Division. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the Owner's Representative. When these specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the specifications shall take precedence.

B. Operating Requirements:

1. Permits: The Contractor shall pay for permits, inspections and other costs incidental to providing electrical installations.
2. Contractor's Record Drawings: The Contractor shall maintain a neatly marked set of record drawings showing the installed location and routing of conduits, trays, cables, junction boxes, pull boxes, outlets, and interconnection circuits, etc., and the current status of control circuits as reflected on the control diagrams to the satisfaction of the Owner's Representative.
3. Inspection: The Contractor shall cooperate with the Owner's Representative and shall provide assistance at all times for the inspection of the electrical work performed under this contract. The Contractor shall remove covers, operate machinery, or perform any reasonable work which, in the opinion of the Owner's Representative, is necessary to determine the quality and adequacy of the work.

C. Quality of Materials

1. All electrical materials used on this project shall be new and free from defects.

2. All electrical materials used on this project shall conform where applicable, to the following standards, unless otherwise noted:
  - a. NEMA - National Electrical Manufacturers Association
  - b. ANSI - American National Standards Institute
  - c. UL - Underwriters Laboratories, Inc
3. Each type of material shall be of the same manufacturer and quality throughout the work.

#### **1.06 Delivery, Storage, and Handling**

- 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 manufacturer's recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in indoor locations that are clean and dry. Items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls store in clean, dry, indoor, heated locations. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in transformers, switchgear, switchboards, motors, and motor control centers which do not bare space heaters.
- B. Shipment: The major equipment items listed in this provision and furnished under this contract shall be shipped in sealed, weather-tight, enclosed conveyances in a manner designed to protect the equipment against damaging stresses during transport.
- C. Inspection
  1. The Contractor shall cooperate with the Owner's Representative and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate machinery, or perform any reasonable work which, in the opinion of the Owner's Representative, will be necessary to determine the quality or adequacy of the work.
  2. If any material does not conform to these specifications the Contractor shall, within three days after being notified by the Owner's Representative, remove the materials from the premises.
  3. Work shall not be closed in or covered before inspection and approval by the Owner's Representative. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor.
- D. Supervision and Workmanship
  1. The Contractor shall employ a competent electrical foreman with good English communication skills on the job throughout the entire period of construction to see that his work is carried on without delay and completed as rapidly as possible.
- E. Cooperative Work with Others
  1. The Contractor shall cooperate with others, with due regard to their work, towards promotion of rapid completion of project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provision in time by Contractor, then he shall bear expense of such changes as necessary to be made in work of others.
  2. Labor and materials, including templates, sleeves, anchors, concrete inserts and the like shall be furnished in ample quantities at such times as necessary to ensure uninterrupted progress of work.
  3. Contractor shall cease work at any particular point temporarily and transfer his operations to such points or execute such portions of work as directed, when in the judgment of the Owner's Representative it is necessary to do so.

## F. Cleanup

1. In addition to the requirements of Special Provisions, in all parts of the materials and equipment shall be thoroughly cleaned. Exposed parts shall be thoroughly clean of cement, plaster, and other materials. All oil and grease spots shall be removed with a non-flammable cleaning solvent. Such surfaces shall be carefully wiped and all cracks and corners scraped out.
2. During the progress of the work, the Contractor shall clean the premises and shall leave the premises and all portions of the site free of debris

## 1.07 Project / Site Conditions

A. General: For purposes of delineating electrical enclosure and electrical installation requirements of this project, certain areas have been classified in the Contract Documents as defined below. Electrical installations within these areas shall conform to the referenced code requirements for the area involved.

### B. Seismic Consideration

1. All structures shall be designed in accordance with the requirements for Seismic Zone 4 of UBC and/or SEAC.
2. Before any concrete pours associated with electrical equipment anchoring can begin, seismic calculations and submittals shall be approved by the Engineer and the Owner's Representative.
3. Each piece of equipment installed shall be anchored as required in the UBC for Seismic Zone 4. No equipment shall be anchored to vertical structural elements without written approval of the Owner's Representative.
4. Vibration isolated equipment shall be provided with snubbers capable of retaining the equipment in its designated location without any material failure or deformation of the snubbers when exposed to a vertical or horizontal force at the contact surface equal to 100 percent of the operating weight of the equipment. Air gaps between retainer and equipment base shall not exceed 1/4 inch.
5. All raceways, ductwork, accessories, and appurtenances, furnished with equipment shall be anchored to resist a lateral seismic force of 40 percent of its operating weight without excessive deflection. This force shall be considered acting at the center of gravity of the piece under consideration.
6. Calculations and shop drawings shall be submitted for all anchorage details. All calculations shall be made and signed by a registered engineer. In as much as all anchorage of equipment is to be made of cast-in-place concrete elements, it is imperative that types of anchorage be coordinated with the concrete contractor so that anchorage may be installed at the time of concrete placement. If calculations and anchorage details are not submitted prior to placement of the concrete, the Contractor shall be responsible for any strengthening of concrete elements because of superimposed seismic loading.

### C. Unclassified Field Locations

1. Field equipment located in interior areas which have not been classified as hazardous locations as defined by the National Electrical Code, Article 500, may be subjected to ambient temperatures varying from 10 degrees F and 115 degrees F and relative humidity ranging from 10 to 90 percent. Incidental quantities of hydrogen sulfide gas and dust also may be present.
2. In exterior areas, ambient temperatures may vary from 10 degrees F and 115 degrees F with strong direct radiation from the sun. Relative humidity in all exterior field areas will vary from

10 to 100 percent with condensation and icing occurring. All areas may have trace quantities of hydrogen sulfide gas with wind blown dust, sand, hail, and rain occurring.

3. In exterior locations, exposed conduits shall be PVC coated Rigid Steel entrances shall be threaded; and fittings shall have gasketed covers. Provisions shall be made to drain the fitting or conduit system. Threaded fastening hardware shall be stainless steel. Mounting brackets shall be galvanized. Attachments or welded assemblies shall be galvanized after fabrication. Instruments and control cabinets, panels, switchboards and motor control centers shall be "Weatherproof NEMA Type 3R." Enclosures shall be mounted 1/4-inch from walls to provide an air space, unless specifically shown otherwise.
- D. Damp Location: Locations which are indoors and 2 feet below grade elevation or which are classified as damp locations on the Drawings shall have electrical installations which conform to the requirements for outdoor locations; except, that the air space from walls may be less than 1/4-inch and enclosures shall be NEMA Type 2. "Damp locations" shall include pipe galleries, tunnels, and basements. All rooms housing liquid handling equipment are also classified as damp locations regardless of grade elevation.
- E. Splash Locations: Areas shown as splash-proof shall have electrical installations as described for "outdoor locations"; except, that NEMA Type 4 enclosures shall be provided for instruments and controls, panels, switchboards, and motor control centers.
- F. Classified Field Locations
1. Field equipment located in hazardous areas shall comply with the National Electrical Code, Article 500.
  2. Hazardous Locations: Areas shown as hazardous shall have electrical installations suitable for Class 1, Division 1, Group C and D locations as required under NFPA 820 and Cal/OSHA Safety orders (Title 8, CCR). Enclosures shall be NEMA type 7.
  3. For this project, hazardous areas of the wastewater facility are as follows:
    - a. None designated
- G. Corrosive Locations
1. Field equipment located in areas subject to ammonia, corrosive fumes, or liquid chemical spills shall utilize materials and equipment specifically for corrosive areas.
  2. Corrosive locations shall have stainless steel threaded hardware; all other electrical hardware, fittings, and raceway systems shall be PVC-coated. Enclosures shall be of fiberglass reinforced polyester or 316 stainless steel and meet NEMA Type 4X requirements.
  3. For this project, the following areas are classified as corrosive:
    - a. Chemical Feed System area of the building
    - b. All WWTP exterior (outdoor)
- H. Electrical Equipment Enclosures
1. Remote electrical units located in electrical equipment enclosures will be subjected to environmental conditions where temperatures may vary from 10 degrees F and 115 degrees F; relative humidity may range from 10 to 100 percent; and dust and trace quantities of chlorine may be present.
  2. In exterior areas, ambient temperatures may vary from 10 degrees F and 115 degrees F with strong direct radiation from the sun. Relative humidity in all exterior field areas will vary from 10 to 100 percent with condensation and icing occurring. All areas may have wind blown dust, sand, hail, and rain occurring

## **1.08 Sequencing and Scheduling**

- A. Sequencing and scheduling plan shall be provided that minimizes facility downtime. Note that the facility must remain operational during all phases of construction. For additional requirements refer to the Special Provisions.

## **1.09 Warranty**

- A. Refer to Section 17506 for requirements

## **1.10 Maintenance**

- A. Information to be provided:

1. The Contractor shall also provide the following additional information for each item of equipment in the operation and maintenance manual required in Section 01300:
  - a. Wiring and interconnection diagrams which show terminal blocks of all distribution and control assemblies; all power, control and signal raceways; junction and pull boxes; all devices; and all interconnecting wiring. Diagrams shall show conductor tag numbers, control wire color code as applicable and power wire and cable sizes.
  - b. The outgoing power and control wires shall be run as single lines representing the raceways and shall show any junction boxes or ancillary control devices that may be located in the raceway system or tapped off the raceway along the route. All raceways shall be appropriately identified showing the proposed tag inscription. Wires are to be fanned out and labeled at each point showing the terminal number of the wire and typical wire tags. For factory wired equipment, both the factory terminal numbers as well as the terminal numbers shown on the contract control diagrams shall be shown. If additional space is required, more than one sheet may be used for the connection diagram.
  - c. Operation and maintenance data
  - d. Maintenance manuals
  - e. Installation certificates

## **PART 2 - PRODUCTS**

### **2.01 Equipment and Materials**

- A. All material and equipment shall be new, free from defects, of current manufacture, and of the quality specified or shown, and shall be listed by the Underwriters Laboratories Inc. (UL) for the purpose for which it is to be used where such listing has been applied by UL to similar products. Each type of material shall be of the same manufacture and quality throughout the work.
- B. Where more than one unit of the same class of material or equipment are required, provide products of a single manufacture. Component parts of materials or equipment of the same manufacturer are preferred.
- C. All electrical equipment shall be approved by a testing laboratory recognized by the Owner and shall conform to all applicable requirements of the latest edition of the California Building Code. In lieu of such approval, the Contractor must submit the equipment for approval to the independent NETA certified electrical testing laboratory. This shall include the plant preferred list of equipment and components specified in the plans and specifications. Contractor shall also include in his delivery schedule the approval time required by the independent NETA certified electrical testing laboratory for equipment without UL listing.

- D. 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.
- E. Equipment Finish: Provide materials and equipment with manufacturers' standard finish system, in accordance with Division 9 Finishes. Provide manufacturers' standard finish color, except where specific color is indicated. If manufacturer has no standard color, finish equipment in accordance with Division 9 Finishes with ANSI No. 61, light gray color.

## **2.02 Fabrication**

### **A. Corrosion Protection**

- 1. Unless otherwise noted, all equipment and appurtenances provided under this section shall be treated with zinc phosphate, bonderized or otherwise given a rust-preventive treatment, then primed and painted with a durable enamel finish. Minimum dry film thickness shall be 3 mils. The Contractor shall ensure that all panels or enclosures specified to be painted in this section shall match in color Plymouth Rock Gray on all exterior surfaces and flat white on all interior surfaces. Nonconforming panels shall be repainted.
  - 2. Field painting of all equipment shall conform to the procedure or outline in applicable sections of the specifications that specify painting and finishing.
  - 3. Galvanizing, where specified, shall conform to the applicable division of the specifications. Galvanized equipment and appurtenances shall not be shop primed or painted but shall be field painted and touched up as specified and directed by the Owner's Representative.
- B. Special Tools: The Contractor shall provide all special tools required for operation and maintenance of the equipment. The tools shall be considered as part of the product and become the property of the Owner.

## **2.03 Source Quality Control**

- A. Hazardous Locations: Provide materials and equipment acceptable to the regulatory authority having jurisdiction for the Class, Division, and Group of hazardous area indicated.

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. Maintain continuity of electric service to all functioning portions of the process or buildings during hours they are normally in use. Temporary outages will be permitted during cutover work at such times and places as can be prearranged with Engineer and the electric utility company providing service to the facility. Such outages shall be kept to a minimum number and minimum length of time. Make no outages without prior written authorization of the Engineer and notification of the Owner's Representative. Include all costs for temporary wiring and overtime work required in the Contract price. Remove all temporary wiring at the completion of the work.

### **3.02 Installation**

- A. For all areas designed as hazardous areas, install all materials and equipment in a manner acceptable to the regulatory authority have jurisdiction for the Class, Division and Group of hazardous area indicated.
- B. Follow manufacturers' installation instructions explicitly, unless otherwise indicated. Wherever any conflict arises between the manufacturers' instructions, codes and regulations, and these Contract Documents, follow Engineer's decision. Keep copy of manufacturers' installation instructions on the jobsite available for review at all times.

- C. Use appropriate conduit and conductor entry fittings with enclosures which maintain the specified enclosure environmental capability after proper installation.
- D. Relocation or Removal of Materials and Equipment:
  - 1. For existing materials and equipment that are to be relocated, remove all materials no longer used such as studs, straps, conduits and wire. Where not required for used in the relocation, remove or cut off concealed or embedded conduit, boxes or other materials and equipment to a point at least 3/4-inch below the final finished surface.
  - 2. For existing materials and equipment that are to be remove, remove all materials no longer used such as studs, straps, conduits and wire. Remove or cut off concealed or embedded conduit, boxes or other materials and equipment to a point at least 3/4-inch below the final finished surface. Any equipment to be removed that is currently is working condition, shall be returned to the Owner unless otherwise noted in the Contract Documents.
  - 3. Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface in a neat and workmanlike manner. Follow any specific instructions given under Division [9], Finishes. Utilize skilled craftsmen of the trades involved.
- E. Cutting and Patching
  - 1. Lay out work carefully in advance. Do not cut or notch any structural member or building surface without specific approval of Engineer or the Inspector. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of conduit, raceways, or other electrical materials and equipment. Following such work, restore surfaces neatly to original condition. Utilize skilled craftsmen of the trades involved.

### **3.03 Field Quality Control**

- A. Each item of equipment provided as a part of this project shall be installed, aligned and tested by skilled workmen to the tolerances recommended by the equipment manufacturer. Provide work which has a neat and finished appearance. Carry out work in accordance with NECA Standard of Installation unless otherwise specified.
- B. Allow materials, equipment, and workmanship to be inspected at any time by the Engineer or the Owner's Representative. 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 and the Owner's Representative.
- C. Testing and Start-Up
  - 1. General
    - a. The Contractor shall furnish all labor, materials, instruments and tools to make all connections for testing as described herein and in Section 16030. All electric power, fuel, water, supplies, and utilities required for all tests shall be provided by the Contractor.
    - b. During checkout and startup of the various plant systems, provide a crew of skilled craftsmen to be available for checkout and troubleshooting activities as required by the ENGINEER. Since coordination with other crafts and Contractors will often be required, the craftsmen assigned to checkout must be available outside normal working hours when necessary.
    - c. All equipment shall be demonstrated as operating properly prior to the acceptance of the work.
    - d. These tests shall be made in the presence of the Owner's Representative and the results will be recorded by the Owner's Representative. All deficiencies or unsatisfactory

conditions, as determined by the Owner's Representative or inspecting authorities, shall be corrected by the Contractor in a satisfactory manner at the Contractor's expense.

2. Protective Devices: All protective devices shall be properly set and operative during the testing period. Before testing and energizing a system, all necessary precautions shall be taken to ensure the safety of personnel and equipment. All conductors and all electrical equipment shall be properly insulated and enclosed. All enclosures for conductors and equipment shall be properly grounded. Insulation resistance measurements must have been made and approved on all conductors and energized parts of electrical equipment.
3. Inspection of Joints: Joints and connections in conductors No. 6 AWG and larger shall be inspected by the Owner's Representative after the joints have been made and prior to application of any tape.
4. Preliminary Testing: After the visual inspection of joints and connections and the application of tape and other insulating materials, all sections of the complete system of wiring shall be thoroughly tested for shorts and grounds. The Contractor shall correct all defects.
5. Insulation Resistance Tests:
  - a. Wire and Cable: All wires and cables to be used as feeders, branch circuit wiring, control circuits and other wiring shall be tested with an insulation resistance tester rated 1000 volts D.C. and capable of measuring 2000 megohms. Single-conductor wires and cable shall have a resistance to ground not less than 200 megohms, and conductors of multiple-conductor cables shall have a resistance to ground not less than 100 meg-ohm. Solid state device circuits shall not be meggered directly. Solid state devices shall be disconnected prior to resistance tests.
  - b. Tests: The insulation resistance of each circuit phase-to-phase and phase-to-ground shall be measured for the following:
    - 1) Motor feeders shall be measured with the motor disconnected.
    - 2) Control circuits shall be measured with pushbuttons, interlocking relays, instruments, overcurrent devices, and the like connected.
    - 3) Lighting feeders to panelboards shall be measured with the branch circuit breakers open.
    - 4) The test shall be made with the branch breakers closed, and with receptacles and fixtures mounted, but before lamping.
    - 5) Power feeders shall be measured with switches and circuit breakers in place.
6. Equipment Tests
  - a. Motor Control Centers/Switchboards -The following tests shall be performed
    - 1) The main bus and all power and control circuits shall be meggered.
    - 2) The wire terminals shall be checked and the connections shall be cleaned.
    - 3) All control switches, alarm devices, and indicating instruments shall be checked for proper operation under normal and simulated abnormal conditions.
    - 4) The thermal-overload heaters and the reset mechanism for each motor shall be checked.
    - 5) The motor nameplate full-load current shall be checked as the basis for checking the heater selection.
    - 6) The thermal-overload heaters shall be in accordance with the starter manufacturer's heater tables for motor enclosure and starter enclosure.

- b. VFD Testing shall be per manufacturers requirements and by the manufacturer's representative as required by the extended warranty requirements.
- 7. Phase Rotation: The connections of all equipment shall be checked for correct phase rotation. Coordinate motor phasing checks with the Engineer/Owner's Representative and the Contractor responsible for the driven equipment. Submit a written report to the Engineer for each motor verifying that phasing has been checked and corrected.
- 8. Circuit Breakers: The following tests shall be performed:
  - a. Inspect each circuit breaker.
  - b. Check for loose connections.
  - c. Operate each circuit breaker manually.
  - d. Set the adjustable trips to the values specified.
- 9. Motor Insulation Testing: Each polyphase motor shall have its insulation resistance to ground measured with 1000 volt "Megger" prior to connection. Values of resistance of less than 100 megohms shall be cause for equipment rejection.
- 10. Thermal Overload Protective Devices
  - a. For each motor, the Contractor shall compile the following data in neatly tabulated form. Data shall be obtained from the equipment provided on the job:
    - 1) Equipment driven
    - 2) Nameplate amperes
    - 3) Service factor
    - 4) Overload device catalog number. Overload device current range and setting

### **3.04 Adjusting / Cleaning / Protection**

- A. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in location of outlets or equipment, prior to roughing in, without incurring any additional costs or charges.
- B. 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 everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls. Provide temporary heating, sufficient to prevent condensation, in transformers, switchgear, switchboards, motors, and motor control centers which do 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 that is acceptable to the Engineer and the Inspector. Cap conduit runs during construction with manufactured seals. Keep openings in boxes or equipment closed during construction. Energize all space heaters furnished with equipment.
- D. Cleaning and Touchup Painting: 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. 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 and the Inspector.

**\*\*END OF SECTION\*\***

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**SECTION 16011  
PROTECTIVE DEVICE COORDINATION STUDY & ARC FLASH ANALYSIS**

**PART 1 - GENERAL**

**1.01 Summary**

- A. The System Integrator (SI) furnishing the electrical panels, or a qualified power system study engineering firm (EF) specified in Section 1.06B hereinafter contracted by the General Contractor (Contractor), shall provide the following electrical power system studies for the project:
  - 1. Arc Flash Hazard Analysis
- B. The Contractor shall be responsible for ensuring that all parties involved in the studies have the necessary information and data to carry out the studies. The SI or EF shall obtain the required information and data from the Electric Utility Company (PG&E), the Owner and the manufacturers of the equipment and materials.
- C. The Owner shall provide the PG&E's contact information to the SI or EF in a timely manner to allow the SI or EF to obtain the required information from PG&E to perform the power study.
- D. The Contractor shall be responsible for ensuring that the Arc Flash Hazard Analysis is completed by the SI or EF and approved by the ENGINEER prior to final approval of the electrical panels.
- E. If during the studies, the SI or EF finds any inadequacies in the equipment or protective devices, the SI or EF shall make recommendations for improvements as soon as they are identified.
  - 1. All electrical cabinets and disconnects must be rated Arc Flash Hazard Risk Category 2 or less.
  - 2. Any locations noted as greater than Arc Flash Hazard Risk Category 2 shall be immediately brought to ENGINEER's attention. Provide recommendation for any corrective measures that can be made to reduce the Arc Flash Hazard Risk Category to 2 or less.

**1.02 References**

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications:

<u>Reference</u>	<u>Title</u>
IEEE 141	Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
IEEE 241	Recommended Practice for Electric Power systems in Commercial Buildings
IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE 399	Recommended Practice for Industrial and Commercial Power System Analysis
IEEE 1015	Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
IEEE 1584	Guide for Performing Arc Flash Hazard Calculations
ANSI C57.12.00	Standard General Requirements for Liquid-Immersed Distribution,

<u>Reference</u>	<u>Title</u>
	Power, and Regulating Transformers
ANSI C37.13	Standard Application Guide for AC High Voltage Circuit Breakers Used in Enclosures
ANSI C37.010	Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
ANSI C37.41	Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single Pole Air Switches, Fuse Disconnecting Switches and Accessories
NFPA 70	National Electrical Code, Latest Edition
NFPA 70E	Standard for Electrical Safety in the Workplace

### 1.03 Definitions

- A. **Arc Flash Boundary:** The distance from exposed live parts within which a person could receive a 2nd degree burn.
- B. **Bus Bolted Fault Current (kA):** The current flowing to a bus fault that occurs between two or more conductors or bus bars, where the impedance between the conductors is zero.
- C. **Bus Name:** Fault location for bus report. For line side and load side report options the bus refers to the equipment where the line side and load side protective devices are connected.
- D. **Breaker Opening Time:** The time required for a breaker to open after receiving a signal from the trip unit to operate. The combination of the Trip/Delay time and the Breaker Opening time determines the total time required to clear the fault. For low voltage circuit breakers, the total clearing time displayed on the Manufacturer's drawing is assumed to include the breaker opening time.
- E. **Equipment Type:** Indicates whether the equipment is Switchgear, Panel, Cable or Open Air. The equipment type provides a default Gap value and a distance exponent used in the IEEE incident energy equations.
- F. **Gap:** Defines the spacing between bus bars or conductors at the arc location.
- G. **Ground:** Indicates whether the fault location includes a path to ground. Systems with high-resistance grounds are assumed to be ungrounded in the Arc Flash calculations.
- H. **Incident Energy:** The amount of energy on a surface at a specific distance from a flash.
- I. **Protective Device Arcing Fault Current (kA):** The current flowing through each protective device feeding the electric arc fault. Note that the total arc fault current may flow through several parallel sources to the arc location.
- J. **Protective Device Bolted Fault Current (kA):** The portion of the total bolted fault current that flows through a given protective device.
- K. **Protective Device Name:** Refers to the protective device that clears the arcing fault or portion of the total arcing fault current.

- L. **Required Protective FR Clothing Class (PPE):** Indicates the Personal Protective Equipment (PPE) required to prevent an incurable burn at the working distance during an arcing fault.
- M. **Trip / Delay Time:** The time required for the protective device to operate for the given fault condition. In the case of a relay, the breaker opening time is entered separately from the relay trip time. For low voltage breakers and fuses, the trip time is assumed to be the total clearing curve or high tolerance of the published trip curve.
- N. **Working Distance:** The distance between the arc source and the worker's face or chest.

#### 1.04 System Description

- A. The scope of the studies shall include all new electrical equipment supplied by the Contactor under this Contract.

#### 1.05 Submittals

- A. Submit a report in PDF format for review by the Engineer. The report shall include the following as further described in Part 3.
  - 1. Summary of the results of the short circuit and the protective device evaluation and coordination studies as required by Arc Flash Hazards Analysis
  - 2. Description, purpose, basis and scope of the study
  - 3. Single line diagram on 11x17 generated by the selected computer program with node identification
  - 4. Tabulations of electrical capacities and characteristics of the equipment and protective devices
  - 5. Table comparing the calculated short circuit and the equipment ratings
  - 6. Coordination curves showing the proposed settings with the characteristics of the equipment and protective devices shown graphically on industry standard graph paper
- B. Submit a subsequent report for review by the Engineer. The report shall include the following as further described in Part 3.
  - 1. Engineer Comments from the preliminary submittal shall be incorporated in the following documents.
    - a. Summary of the results of the short circuit and the protective device evaluation and coordination studies as required by Arc Flash Hazards Analysis.
    - b. Description, purpose, basis and scope of the study
    - c. Single line diagram generated by the selected computer program with node identification
    - d. Tabulations of electrical capacities and characteristics of the equipment and protective devices
    - e. Table comparing the calculated short circuit and the equipment ratings
    - f. Coordination curves showing the proposed settings with the characteristics of the equipment and protective devices shown graphically on industry standard graph paper
  - 2. Arc Flash Hazard Analysis to include computed incident energy levels and flash protection boundary distances.
- C. Submit study report within 30 days after shop drawings have been returned for the electrical panels. These shop drawings may have / may have not been approved by the ENGINEER.

- D. Submit subsequent study report based on the APPROVED shop drawings for the electrical panels. It may be necessary to modify the design of the electrical panels based on the recommendations included in the Final study report.
- E. The electrical panels shall not be constructed until approval of the Final study report.
- F. The final version of the Arc Flash Hazard Study and Arc Flash Warning Labels shall be submitted at least 30 days prior to energizing the electrical equipment.
- G. Provide three (3) hard copies of the final power system studies, one electronic copy of the final power system studies, software modeling & library files, and one (1) set of warning labels to be affixed on the electrical panels.

### **1.06 Quality Assurance**

- A. The Contractor shall have the study prepared by SI's or EF's qualified engineer. The SI's or EF's engineer shall be a California Registered Professional Electrical Engineer who has at least five years of experience and specializes in performing power system studies.
- B. By the ENGINEER's approval, the Contractor may contract with an independent power system study engineering firm who shall demonstrate experience with Power System Studies to perform the Arc Flash Analysis. This engineering firm shall submit to the ENGINEER its qualifications and names of at least five clients who this engineering firm has performed Power System Studies in the last three years.
- C. The studies shall be performed using computer software from a single software company, SKM PowerTools for Windows, or approved equal.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. The SI or EF to furnish short-circuit and protective device coordination studies as required by Arc Flash Hazards Analysis shall collect all required data and information in coordination with PG&E, equipment manufacturers, Contractor, and Owner. Certain information may be available from the ENGINEER upon request by the SI or EF
- B. Contractor shall ensure that all data as required by the power system studies is furnished to the SI or EF in a timely manner. The Engineer performing the Arc Flash Hazard Analysis shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the electrical equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- C. The Arc Flash Hazard Analysis shall be per NFPA 70E- Standard for Electrical Safety in the Workplace, reference Article 130.3, and Annex D

### **3.02 Execution**

- A. Short-Circuit Analysis
  - 1. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
  - 2. Transformer design impedances shall be used when test impedances are not available.

3. Calculation of the maximum rms symmetrical three-phase short-circuit current at each significant location in the electrical system shall be made using a commercially available computer program.
4. Appropriate motor short-circuit contribution shall be included at the appropriate locations in the system so that the computer calculated values represent the highest short-circuit current the equipment will be subjected to under fault conditions.
5. A tabular computer printout shall be included which lists the calculated short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings, and notes regarding the adequacy or inadequacy of the equipment.
6. The study shall include a computer printout of input circuit data including conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions, and other circuit information as related to the short-circuit calculations.
7. The system one-line diagram shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis.
8. The computer printout shall identify the maximum available short-circuit current in rms symmetrical amperes and the X/R ratio of the fault current for each bus/branch calculation.
9. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.
  - a. Evaluate equipment and protective devices and compare to short circuit ratings.
  - b. Adequacy of switchgear, automatic transfer switch, enclosed circuit breaker, motor control center and panelboard bus bars to withstand short-circuit stresses.
  - c. Notify Engineer in writing, of circuit protective devices improperly rated for the calculated available fault current.

#### B. Protective Device Time-Current Coordination Analysis

1. Perform a protective device coordination study to select fuse ratings, ratios and characteristics of associated voltage and current transformers, breaker trip characteristics and settings. Include all voltage classes of equipment from the utilities incoming line protective device down to and including all Main Service Breaker, Enclosed Circuit Breaker (for Stationary Generator Connection), main breakers for all motor control centers, main breakers for all control panels, and, at each motor control center provide the motor circuit breaker for each motor size that is greater than 20 HP. Include a description, purpose, basis, and scope of the study and a single line diagram of the portion of the power system which is included within the study. Note inadequacies found during the study.
2. The time-current coordination analysis shall be performed with the aid of a commercially available computer program. It shall include the determination of settings, ratings, or types for the protective devices supplied.
3. Where necessary, an appropriate compromise shall be made between system protection and service continuity with system protection and service continuity considered to be of equal importance.
4. A sufficient number of computer generated log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.

5. Provide time-current curves graphically indicating the coordination proposed for the system, centered on conventional, full size log-log forms. Include with each curve sheet a complete title and one line diagram with legend identifying the specific portion of the system covered by that particular curve sheet. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics. Include the following on the curve sheets, where applicable:
  - a. Power Company relay and fuse characteristics
  - b. Low-voltage equipment circuit breaker trip device characteristics
  - c. Low-voltage fuse characteristics
  - d. Pertinent transformer characteristics
  - e. Pertinent motor and generator characteristics
  - f. Characteristics of other system load protective devices
  - g. Show transformer full load and 150%, 400%, or 600% currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and symmetrical and asymmetrical fault currents at each switchgear and panelboard
  - h. Motor overload characteristics
  - i. Conductor damage curves
6. Include with the report the manufacturer's time-current curves for all protective devices.
7. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, the short-circuit current availability at the device location when known, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
8. The study shall include a separate, tabular computer printout containing the suggested device settings of all overcurrent protective devices, the equipment where the device is located, and the device number corresponding to the device on the system one-line diagram.
9. A computer generated system one-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.
10. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for increasing system protection or device coordination.
11. Significant deficiencies in protection and/or coordination shall be called to the attention of the engineer and recommendations made for improvements as soon as they are identified. Report shall also include suggestions to:
  - a. Improve coordination between upstream and downstream devices
  - b. Reduce fault current clearing times of upstream devices
  - c. Identify equipment protection boundary and inrush current conflicts

#### C. Arc Flash Hazard Analysis

1. Per NEC 110.16, perform an arc-flash analysis according to IEEE Standard 1584, "IEEE Guide for Performing Arc Flash Hazard Calculations," based upon results from the short circuit current analysis and optimized overcurrent protective device settings provided in the overcurrent protective device coordination study. Determine the following:
  - a. Flash Hazard Protection Boundary

- b. Limited Approach Boundary
  - c. Restricted Boundary
  - d. Incident Energy Level
  - e. Required Personal Protective Equipment Class
  - f. Type of Fire Rated Clothing
2. The arc flash hazard study shall include the electrical distribution system equipment shown on the single line diagrams of the contract documents. The arc flash hazard study shall be used in conjunction with the approved short circuit and protective device coordination studies. The results of the power system studies shall be present in a report format that includes the following sections:
    - a. Introduction, executive summary and recommendations, assumptions, reduced copy of the single line diagram
    - b. Arc Flash Evaluations Summary Spreadsheet
    - c. Bus Details Sheets
    - d. Arc Flash Warning Labels printed in color on adhesive backed labels
  3. A detailed arc-flash hazard analysis report with computed incident energy levels (Calories per square inches) and flash protection boundary distances at equipment indicated above to insure adequate protection and safety of personnel working in the vicinity of electrical equipment.
  4. Arc Flash Hazard warning stickers, sized a minimum of 3.5" x 5" with the seven items listed in paragraph A above shall be located so as to be clearly visible to qualified persons on the existing and new electrical equipment including switchboards, motor control centers, power distribution panels, and panelboards. The labels shall include the bus name; upstream Protective Device Name, Type and Settings; bus line to line voltage and printed in color on adhesive backed Avery Labels.
    - a. For each 600, 480, 240, and applicable 208 volt panelboard, one arc flash label shall be provided
    - b. For each low voltage switchboard section and drives, one arc flash label shall be provided

### **3.03 Implementation**

- A. General: Analyze the short circuit, protective device coordination, and arc flash calculations and highlight any equipment that is determined to be underrated or causes an abnormally high incident energy calculation. Propose approaches to reduce the energy levels Proposed major corrective modification will be taken under advisement by the Engineer, and the Contractor will be given further instructions.
- B. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- C. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- D. Notify Engineer in writing of any required major equipment modifications.
- E. Arc Flash Training: The SI or EF shall train the Owner's qualified electrical personnel of the potential Arc Flash Hazards and Shock Hazards associated with working on energized equipment (minimum of 4 hours). The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET) or equivalent.

**\*\*END OF SECTION\*\***

## **SECTION 16030 ELECTRICAL TESTS**

### **PART 1 - GENERAL**

#### **1.01 Summary**

- A. This Section specifies the work necessary to test, commission and demonstrate that the electrical work satisfies the criteria of these Specifications and functions as required by the Contract Documents.
- B. The work of this Section includes furnishing the labor, equipment and power required to support the testing specified in other Divisions of these Specifications. Electrical testing specified herein, and functional testing of all power and controls not tested under Division 17, Instrumentation and Control shall be completed before commencement of plant start-up. This scope may require the Contractor to activate circuits, shutdown circuits, and run equipment, make electrical measurements, replace blown fuses, install temporary jumpers, etc.

#### **1.02 References**

- A. NETA Latest Edition

#### **1.03 Submittals**

- A. Test procedures, test data and test reports upon completion of each phase of testing.

#### **1.04 Quality Assurance**

- A. The following test requirements are intended to supplement test and acceptance criteria that may be stated elsewhere.
  - 1. Lighting:
    - a. Switching, including remote control, as shown.
    - b. Circuitry is in accordance with panel schedules.
    - c. Lighting fixtures located to minimize obstruction of illumination by mechanical equipment or building structural elements.
  - 2. Power Metering:
    - a. Demonstrate that voltmeter and ammeter switches are functional.
    - b. Demonstrate that meters are within catalog accuracy as installed with specific reference to kilowatt meters.
    - c. Demonstrate that meters are properly programmed to display all parameters.
  - 3. Demonstrate mechanical and/or electrical interlocking by attempting to subvert the intended sequence.
  - 4. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known, and reasonable, current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.
  - 5. Cable Testing:
    - a. 480-volt circuits shall be tested for insulation resistance with a 2000-volt megohm meter.
    - b. Testing shall be done after the 480-volt equipment is terminated.

- c. Test results shall be submitted for review 30 days prior to plant operation and any system testing. Equipment which may be damaged during this test shall be disconnected.
  - d. Perform tests with all other equipment connected to the circuit. In order to be acceptable, the cable must withstand the test high voltage without breakdown, have steady or decreasing leakage current during the high potential test, and have satisfactory comparable megger readings in each megger test.
  - e. Test results shall be submitted to the engineer and shall state equipment used and time of test
  - f. Cable testing and report submittal shall be performed by an organization sanctioned by the Manufacturer of the cable to be tested.
  - g. Testing shall verify the quality of cable terminations
6. Test ground fault interrupter (GFI) receptacles and circuit breakers for proper operation by methods sanctioned by the receptacle Manufacturer.
7. A functional test and check of all electrical components is required prior to performing subsystem testing and commissioning. Components and equipment shall be cleaned as required by other provisions of these Specifications before commencement of functional testing. Functional testing shall comprise:
- a. Visual and physical check of cables, buss work, circuit breakers, transformers, and connections associated with all new and modified equipment.
  - b. Setting of protective relays in conformance with results of the Protective Devices Coordination Study and testing of relays to assure that relays will operate at the current value and time required by the Study.
  - c. Circuit breakers which are specified with adjustable time or pick-up settings for ground current, instantaneous overcurrent, short-time overcurrent, or longtime overcurrent, shall be field adjusted by a representative of the circuit breaker Manufacturer. Time and pickup setting shall correspond to the recommendations of the Protective Devices Coordination Study. Setting shall be tabulated and proven for each circuit breaker in its installed position; test results shall be certified by the tester and transmitted to the Engineer (7 copies).
8. Complete ground testing of all grounding electrodes and grid prior to testing the equipment.
- B. Subsystem testing shall occur after the proper operation of alarm and status contacts has been demonstrated or otherwise accepted by the Engineer and after process control devices have been adjusted as accurately as possible. It is intended that the Contractor will adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.
- C. After initial settings have been completed, each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract Documents. Once the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.
- D. Motor operated valves shall be tested after having been phased and tested for correct motor rotation and after travel and torque limit switches have been adjusted by a representative of the valve Manufacturer. Tests shall verify status indication, proper valve travel, and correct command control from local and remote devices.
- E. Subsystems, in the context discussed here, shall mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, etc.

- F. Start-up commissioning shall not be attempted until all subsystems have been found to operate satisfactorily. Start-up shall only be attempted as a function of normal plant operation in which plan process flows and levels are routine and equipment operates automatically in response to flow and level parameters shall be considered only upon receipt of a written request by the Contractor.
- G. The motor current tabulation required by Section 16011, "Short Circuit and Coordination Report", shall reflect the values occurring during start-up. The indications of all switchboard ammeters and kilowattmeters shall be recorded every half-hour during commissioning.

## **PART 2 - (NOT USED)**

## **PART 3 - EXECUTION**

### **3.01 Field Quality Control**

- A. Conductors Field Test, Conductors Rated 600 Volts or Less:
  - 1. Perform insulation resistance testing of all power and control circuits 600 volts and less with a 2000-volt megger.
  - 2. Prepare a written test report of the results and submit to the Engineer prior to final inspection.
  - 3. Minimum acceptable value for insulation resistance is 100 mega-ohm.
  - 4. Disconnect equipment that might be damaged by this test. Perform tests with all other equipment connected to the circuit.
- B. Conductors Field Test, Instrumentation Cables
  - 1. After instrumentation cable installation and conductor termination by the instrumentation and control supplier, perform tests witnessed by the Engineer to ensure that instrumentation cable shields are isolated from ground, except at the grounding point. Remove all improper grounds.
- C. Grounding, Field Tests:
  - 1. Test in the Engineer's presence the ground resistance of the grounding system. Ground resistance value shall be 5.0 ohms or less..
  - 2. Test all ground fault interrupter (GFI) receptacles and circuit breakers for proper connection and operation with methods and instruments prescribed by the manufacturer.
  - 3. Provide copies of reports of all grounding system tests for inclusion in Technical Manuals and for review by the Engineer.
  - 4. Provide ground resistance tests in the presence of the Engineer and submit results. Utilize a ground resistance megger "Earth"tester with a minimum resistance capacity range of 0-5000 megohms at 2000 VDC. Utilize the full potential method or the three terminal method as described by Biddle or NETA national electrical test association
- D. Motor Control, Factory Tests:
  - 1. The motor control centers and their components shall be given manufacturer's standard electrical and mechanical production tests and inspections with complete test reports; submitted to the Engineer for approval. These tests shall be conducted in conformance with the requirements of IEEE, NEMA, UL and ANSI Standards. The results of tests shall verify that the complete motor control centers with their components comply with all performance requirements specified.

2. As a minimum, motor control centers and their components shall be subjected to the following tests.
  - a. All motor control centers shall be tested in accordance with NEMA ICS-2.
  - b. Production dielectric tests on motor control center assemblies shall be made at the power frequency in accordance with NEMA ICSI-109.
  - c. Motor control center performance tests shall meet the requirements of NEMA ICS 2-324.
  - d. Mechanical operation tests to assure proper functioning of components and the interchange ability of all identical components and plug-in modules within and between motor control centers.
  - e. Each motor control center shall be given factory standard inspection and tests which shall include, but not be limited to electrical continuity check, dielectric tests for each circuit and inspection for proper functioning of all components, including control protective, monitoring, metering, and alarm devices.
  - f. All system components shall be tested in accordance with the procedures and requirements of the following standards; NEMA SG-2, NEMA FU-1, NEMA ICS-2, and ANSI-C37.20.

E. Motor Control, Field Tests:

1. Functional Test: Prior to plant startup, all equipment shall be inspected for proper alignment, proper connection, proper operation of control and instrumentation, proper rotation, and satisfactory starting operation of the indicated motor.
  - a. Test all starters for proper contactor action, proper interlocks and permissives operation, and proper indication prior to applying power to motor.
  - b. Approval of Engineer prior to energizing motors is required;
2. All functional and field tests are required to be performed in the presence of the Engineer or Owner's Representative.

F. Transformers, Field Tests

1. The transformer manufacturer shall provide an authorized service representative for field installation, testing, and start-up assistance and for the instruction of Owner's operation personnel in the proper operation, service, and maintenance of the transformers, in accordance with **MANUFACTURER'S FIELD SERVICES** of the General Requirements. The manufacturer's representative shall certify in writing to the Engineer that the equipment has been correctly installed and shall submit certified copies of the field test results. No equipment is to be energized until testing has been completed to the satisfaction of the Engineer. The following minimum tests and checks shall be made before the transformers are energized:
  - a. Insulation resistance tests shall be performed between each winding to every other winding, and to ground.
  - b. Insulating oil shall be sampled. Sample shall be laboratory tested for:
    - 1) Moisture Content
    - 2) Dielectric strength
    - 3) Acid neutralization
    - 4) Interfacial tension
    - 5) Color
    - 6) Power Factor

7) Moisture Content

c. Test Values

- 1) Absorption test polarization index shall be above 2.0 unless an extremely high value is obtained at the end of one minute, that when doubled will not yield a meaningful value with the available test equipment
- 2) Turns ratio test result shall not deviate more than one-half of one percent (0.5%) from calculated ratio
- 3) Pattern of exciting-current test data; two similar current readings for outside phases and a lower current reading for the center of a three-phase unit
- 4) Care must be taken to avoid the influence of residual magnetism on test data. (Sources include impulse and winding resistance tests)
- 5) Dielectric fluid shall comply with the following:
  - a) Dielectric breakdown (ASTM D 877)
  - b) Neutralization number (ASTM D 974)
  - c) Interfacial tension (ASTM D 971)
  - d) Color (ASTM D 1500) 1.0 maximum
  - e) PPM Water (refer to vendor's specifications)
  - f) Power factor at 25° 0.1 percent maximum
- 6) Winding resistance test results shall compare within 1% of the design value
- 7) AC high-potential test voltage shall not exceed 75% of the factory test voltage for a one minute duration. Evaluation shall be on a go/no-go basis, per ANSI C57.98.
- 8) Impedance test results shall be within  $\pm 7.5\%$  of design value for 2-winding transformers

G. Surge Arrestors

1. The manufacturer shall provide copies of design test data on the arrester provided showing that the arrestors are in compliance with: IEEE C62.2 Guide for application of Gapped Silicon - Carbide Surge Arrestors for AC systems.
  - a. IEEE C62.11 Standard for Metal Oxide Surge Arrestors for AC Power Circuits
  - b. IEEE CC2.22 Guide for Application of Metal Oxide Surge Arrestors for AC Systems
2. The following tests shall be made on each arrester in conformance with ANSI 62.1:
  - a. Power frequency spark over
  - b. Radio influence voltage
  - c. Sealing
3. The design test data and the individual arrester test results shall be certified and submitted.

H. Uninterruptible Power System, Factory Tests

1. The UPS shall be tested in accordance with the following test procedures. A test report showing that the equipment has passed the factory tests and has demonstrated the capability to support the load, as required by this specification, shall be available promptly after completion of the tests. A test battery shall be available for assuring proper operation of the UPS with a battery.

2. System Log: Establish a log to record all tests performed and results, and record any failures and corrections made during test, should any occur
  3. Visual Inspection:
    - a. Check for all Quality Assurance Stamps
    - b. Inspect Interior
  4. Dielectric Tests:
    - a. Check for charger shorts
    - b. Check for dc shorts
  5. Efficiency Test: Measure module efficiency by dividing inverter output power by the charger input power with a fully charged battery connected and float charger. Verify compliance with specifications under the following loads:
    - a. Half load, 1.0 power factor
    - b. Full load, 1.0 power factor
- I. Uninterruptible Power System, Field Tests
1. Demonstrate that upon finish of initial charge, and after having been on float charge for at least 72 hours, that individual cells, or monoblocks (each individual battery), are within the manufacturer's specifications
  2. Demonstrate that the DC bus is supplying voltage within manufacturer's specifications and is compatible with battery manufacturer's specifications
  3. Demonstrate the external bypass switch removes the UPS from the system without dropping out any loads
  4. Same as #3 above with the internal bypass switch
  5. Demonstrate the UPS will remain on line for a minimum of 8 hours under full load conditions without tripping to static bypass
  6. Demonstrate, upon removal of AC input power, the UPS will power all UPS loads automatically, without interruption
  7. Measure the run time of the UPS, with loss of AC input power, under full rated load conditions until lower battery limit is reached. This time shall comply with battery size and rating. If connected load is less than UPS full rated load contractor shall provide external loads.
- J. Standby Engine Generator Set, Factory Test
1. The engine generator unit shall be tested at the manufacturer's plant before shipment. The test shall consist of a steady load run of at least 60 minutes duration at 100 percent full-rated load. Complete test reports shall be made which shall show the engine fuel consumption and kW output. Test results shall be reviewed by the Engineer prior to shipment.
- K. Standby Engine Generator Set, Field Test
1. Upon completion of the engine installation, running tests shall be carried out. The engine shall be operated for a period of not less than 2 hours and all necessary adjustments made by a factory representative of the engine manufacturer. The test shall demonstrate the ability of the engine generator to carry the specified loads. Upon completion of the tests, final adjustments shall be made to the equipment, fuel and oil filters shall be replaced, belt drive tensions checked, and the proper operation of all equipment demonstrated to the Engineer and the Owner's representative. The Engineer shall be instructed in the maintenance and operation of the equipment.

2. Load starting capability: The engine shall be able to start out under ½; 3/4 and full load
  3. The engine shall maintain voltage and frequency regulation during starting of ½: 3/4 and full load
  4. Automatic starting feature upon loss of regular source of power
- L. Standby Power System Transfer Switch, Factory Test
1. Alarm and Status indicating devices shall be factory checked for proper operation as described in specification Section 16261.
- M. Standby Power System Transfer Switch, Field Test
1. Test of system shall be done as operation described in Section 16261
  2. Protective and control relays shall be Field Calibrated and Tested based on set values of the Coordination Study at the stand by system and or manufacturers recommendation
  3. Alarms and status indicating services shall be field checked for proper operation as described in specification Section 16261. Instrumentation loops shall be field checked-calibrated as indicated in Instrumentation section.

### **3.02 ELECTRIC MOTORS**

- A. Tests shall be performed as per ANSI/IEEE standard 112-1978 “IEEE Standard Test Procedure for poly phase Instruction Motors and Generates”.

### **3.03 ADJUSTABLE FREQUENCY DRIVES**

- A. Accessories: Each drive shall be supplied with a magnetic contactor at the output terminals. The contactor shall be NEMA rated for at least the horsepower rating of the motor. The contactor shall be located within the enclosure of the adjustable frequency drive and shall be part of the packaged unit.
1. The output contactor shall be electrically interlocked with the input circuit breaker such that when the circuit breaker is opened, the drive is disconnected from the motor, and when the circuit breaker is closed, the drive is connected to the motor.
  2. A warning nameplate shall be provided on each drive to warn the operator to trip the circuit breaker prior to performing any maintenance.
- B. Testing: The drive manufacturer shall conduct all standard test in accordance with NEMA and ANSI standards to ensure conformance to specification requirements. All power switching components shall be prerun under temperature and load conditions.
- C. Factory Testing: After the system has been assembled at the drive manufacturer’s facility, a system test shall be performed before the drive package is shipped to the manufacturer of the driven equipment. The system test shall be not less than 24 hours in duration. The drive package shall be free of faults following the test.
1. The complete drive system, including all peripherals, shall be factory tested under simulated operating conditions. Normal operating sequences and fault conditions shall be simulated during the testing. Contact closure inputs and simulated driven-outputs shall be connected to the system input/output modules.
  2. A test report summary, indicating satisfactory final test results, shall be submitted to the Engineer prior to shipment of the equipment.
- D. Secondary Factory Testing: The drive manufacturer shall provide the services of a qualified representative to work with the equipment manufacturer at the equipment manufacturer’s facility to

advise and assist in assembly of the equipment and drive unit packages and the performance of the specified tests.

1. Personnel conducting the tests shall be competent authorized representatives of the equipment and drive unit packages and the performance of the specified tests.
  2. Personnel conducting the tests shall be competent authorized representatives of the equipment and drive manufacturers who are familiar with operation of the equipment furnished and who have previous satisfactory experience in conducting similar tests.
  3. Qualified personnel shall perform the tests, record the data, make the required calculations, and prepare a report on the results; five copies of the report shall be submitted to the Engineer. The Engineer may observe the tests and collect a copy of the recorded data. The information collected will be used as a basis for determining acceptability of the manufacturer's results. In case of conflict, interpretations and calculations made by the Engineer will govern.
  4. Testing shall be performed in a manner acceptable to the Engineer. At least 2 weeks prior to the proposed testing date, the Contractor shall notify the Engineer of the testing date and shall submit a report from the equipment manufacturer detailing the proposed performance testing.
- E. Field Acceptance Testing: After installation of the system at the site of the work and checkout by the drive manufacturer, a field acceptance test shall be performed by the drive manufacturer in conjunction with the manufacturer of the driven equipment.
1. The field acceptance test shall consist of a repeat of the factory testing procedure and an additional 5 days of similar testing during which the system shall run continuously without loss of basic functions.
  2. Functional tests shall demonstrate satisfactory operation to all interlocks, alarms, and normal operation sequences.
  3. The supplier shall use suitable test equipment to locate the source of trouble or malfunction.
  4. Failure of redundant equipment will not be considered as downtime, provided automatic fail over occurs as specified herein and, in the opinion of the Engineer, the failure was not caused by deficiency in design or installation.
  5. Repeated failure of any component shall cause the acceptance test to be terminated and restarted.
- F. Harmonic Distortion Test:
1. The Contractor shall provide temporary four-channel power line monitoring equipment for a period of at least 30 calendar days to graph record the harmonic line distortion for ac voltage, dc voltage, and current, and to compute individual harmonic values up to the 17th harmonic as well as total harmonic distortion (THD).
  2. The monitoring equipment shall include a four-channel power line monitor, temperature and humidity compensation probes, a recorder, and additional options required to compute harmonic values and THD. The equipment shall be Basic Measuring Instruments, Dranetz or equal.
  3. Measurements shall include phase-to phase, phase-to-neutral, neutral-to-ground, and dc power. The harmonic distortion shall be monitored at the connection point of each drive, at motor control center buses common to more than one drive, at the service entrance, and at other locations as directed by the Engineer.
  4. The test shall be run for the full range of drive operation as is practicable. The test shall be conducted by a qualified individual acceptable to the Engineer

**\*\*END OF SECTION\*\***

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## SECTION 16110 RACEWAYS, FITTINGS, AND SUPPORTS

### PART 1 - GENERAL

#### 1.01 Summary

- A. Scope: This section provides specifications for all raceways, wire ways, raceway supports, cable trays and concrete encased ducts.
- B. Type:
1. All conduits shall be polyvinyl chloride (PVC), Schedule 40 for under concrete slabs and raceway duck banks.
  2. All direct buried conduits in earth shall be polyvinyl chloride (PVC), Schedule 80.
  3. All conduits installed exposed in electrical rooms and non-corrosive areas shall be Galvanized Rigid Steel (GRS).
  4. All conduits installed in corrosive areas shall be PVC coated Rigid Steel Conduit (PVC-RSC).
  5. All conduits for VFD power feeders and VFD controlled motors, where VFD type cable is not used, shall be either RSC or PVC-RSC as specified above.
  6. All conduits for VFD power feeders and VFD controlled motors, where VFD type cable is used, shall be either PVC or PVC-RSC as specified above.
  7. All conduits installed exposed outside shall be PVC-RSC.

#### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
ANSI C80.1	Electrical Rigid Steel Conduit
UL 1	Flexible Metal Conduit
UL 5	Surface Metal Raceway and Fittings
UL 6	Electrical Rigid Metal Conduit – Steel
UL 514B	Conduit, Tubing and Cable Fittings
UL 651	Schedule 40 and 80 Rigid PVC Conduit and Fittings
NEMA RNI-2005	PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC-2-2003	Electrical PVC Tubing and Conduit
NEMA TC-3-2004	PVC Fittings for Use With Rigid PVC Conduit and Tubing
ANSI/UL 467	Grounding and Bonding Equipment
NEC	National Electric Code, latest edition

### **1.03 Submittals**

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010. Submittals shall include the following data, drawings, and description of materials.
  - 1. Manufacturer and manufacturer's type and designations for each equipment item
  - 2. List of construction material for all conduits, fittings, supports and accessories
  - 3. The Contractor shall furnish copies of the manufacturer's certified test reports for the material being supplied to establish compliance with NEMA RN-1

### **1.04 Quality Assurance**

- A. Performance and Design Requirements: The conduits and fittings shall be premium quality and suitable for installation in wastewater facilities. The PVC used for Schedule 40 and 80 conduits and the PVC coating on rigid steel conduit shall be made from virgin material.
- B. Inspection: All raceway duct banks shall be inspected by the Engineer prior to backfill. The Engineer shall inspect for drainage slope, spacers, conduit condition, and joints.
- C. All equipment furnished by the Contractor shall be listed by and bear the label of Underwriters' Laboratories, (UL) or of an independent testing laboratory acceptable to the Owner.

### **1.05 Delivery, Storage, and Handling**

- A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Site Engineer, and secure from weather or accidental damage.

### **1.06 Project / Site Conditions**

- A. The raceways, fittings, and supports will be installed either exposed, concealed, or in duct banks in a wastewater facility and may be subjected to hydrogen sulfide gas, dust, moisture, and methane gas. Ambient temperatures are expected to range between 10 degrees F and 115 degrees F. Relative humidity should range from 10 percent to 100 percent. The raceways, fittings, and supports may be subject to hydrogen sulfide gas, dust, moisture, and methane gas.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with Section 01600 – Material and Equipment Substitution.

### **2.02 Equipment and Materials**

- A. All raceways shall be as specified in Section 1.01B.
- B. Flexible metal conduit shall be employed for connections to lighting fixtures. Final raceway runs to electrical equipment on machinery requiring flexibility or that is subject to vibration shall be liquid-tight flexible metal conduit.
- C. All fittings and supports shall match the conduit types specified in Section 1.01B.
- D. Minimum size of all conduits shall be 3/4-inch.
- E. Rigid Steel Conduit

1. Comply with Underwriter's Laboratories UL-6 specification, ANSI C80.1-77 and Federal specification WW-C-581E (77 APR 04) or latest revisions. Rigid steel conduit shall be zinc coated both inside and outside after fabrication by hot-dip galvanizing. The threads shall also be hot-dip galvanized.
2. Use rigid steel conduit, including bushings, couplings, elbows, nipples, and other fittings, galvanized by hot-dipping, and meeting the requirements of ANSI C80.1 and ANSI C80.4, UL.
3. Do not use setscrew type couplings, bushings, bends, nipples, and other fittings, unless approved by the ENGINEER or the INSPECTOR. Factory bends are not permitted unless approved by the ENGINEER or the INSPECTOR. Conduit bending radius shall not be less than the minimum cable bending radius of the cable to be installed.

#### F. PVC Conduit:

1. Nonmetallic conduit shall be high impact polyvinyl chloride (PVC), Schedule 40 or 80 as specified. The nonmetallic conduit shall be corrosion resistant. Minimum tensile strength shall be 6000 psi, and minimum compressive strength shall be 9000 psi. The material shall have a smoke emission rate of not more than 5.1 grams/100 grams by the Arapahoe smoke chamber test.
2. Use rigid PVC Schedule 40 conduit, UL listed for concrete-encased and under concrete slabs.
3. Use rigid PVC Schedule 80 conduit, UL listed for underground direct burial for use with conductors having 90 degrees C insulation.
4. Use conduits, couplings, bushings, elbows, nipples, and other fittings meeting the requirements of NEMA TC 2 and TC 3, Federal Specification W-C-1094, UL, NEC, and ASTM specified tests for the intended use.

#### G. PVC Coated Rigid Steel

1. PVC coated conduit shall be hot-dip galvanized including the threads. The interior and exterior surfaces shall be coated with 2 mils thick urethane. The exterior of the conduit shall be PVC coated to a minimum 40-mil thickness. The PVC coating shall be permanently bonded to the conduit. The coating shall have a minimum tensile strength of 3500 psi. The interior shall be coated with a urethane coating no more than 7 mils thick.
2. A PVC coated coupling shall be furnished with each length of conduit. The PVC sleeve of the coupling shall equal the outside diameter of the coated conduit and shall extend 1-1/2 inches from each end of the coupling.
3. Prior to coating, the galvanized conduits and fittings shall be UL listed. Use PVC coated fittings with the same interior and exterior coating requirements. PVC coated fittings and sleeves shall be completely watertight to prevent moisture from penetrating the interior of the conduits and fittings.
4. The PVC coating shall be resistant to ultra-violet rays when installed outdoors. The conduit and fittings shall meet all the requirements of NEMA RN-1 1989.

#### H. Flexible Metal Conduit

1. Flexible metal conduit shall be formed from spirally wound galvanized steel strip with successive convolutions that are securely interlocked. Minimum size of the flexible metal conduit shall be 3/4 inch. Fittings shall be of the compression type. Lengths shall not exceed 60 inches. Flexible metal tubing shall include a code size insulated green ground conductor.

#### I. Flexible Metal Conduit, Liquid-Tight

1. Use UL listed liquid-tight flexible metal conduit consisting of galvanized steel flexible conduit 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.
2. Provide external grounding connector and appropriately sized grounding conductor to assure ground continuity.
3. Minimum size shall match the connecting non-flexible conduit.

#### J. Wireways

1. All wireways and auxiliary gutters shall be JIC sectional flange oil-tight type with hinged covers. Minimum size shall be 8 inches by 8 inches unless otherwise noted. All wireways shall be painted.
2. Provide outdoor, rain-tight steel-enclosed wireway and auxiliary gutter where indicated. Utilize wireways and fittings that are UL listed, and have a cover that can easily be removed. Manufacturers and types: Square D Square-Duct; General Electric Type HS; or equal.

### 2.03 Components and Accessories

- A. Fittings in Hazardous Areas: In hazardous areas, use only fittings approved for the atmosphere involved.
- B. Use cable sealing fittings forming a watertight nonslip connection to pass cords and cables into conduit. Size cable sealing fitting for the conductor OD. For conductors with OD's of ½-inch or less, provide a neoprene bushing where the conductor enters the connector. Use Crouse-Hinds CGBS, Appleton CG Series, or equal, cable sealing fittings.
- C. Fittings for Rigid Steel
  1. Fittings used with rigid galvanized steel conduit shall be hot-dip galvanized. Locknuts shall be extra heavy galvanized steel for sizes through 2 inches. Locknuts larger than 2 inches shall be galvanized malleable iron. Bushings shall be galvanized malleable iron with insulating collar. Grounding bushings shall be of the locking type and shall be provided with feed-through compression lugs for securing the ground cable. Unions shall be galvanized ferrous alloy types UNF or UNY. Thread-less fittings shall not be utilized with rigid galvanized steel conduits.
  2. Expansion fittings in embedded runs shall be of the watertight type and shall be provided with an internal bonding jumper. The expansion material shall be neoprene and shall allow for 3/4-inch movement in any direction.
  3. Use insulated throat bushings of metal with integral plastic bushings rated for 105 degrees C.
  4. For insulated throat bushings for rigid steel conduit, use Thomas & Betts Nylon Insulated Metallic Bushings, or O.Z. Gedney Type B, or equal.
  5. Use Myers Scru-Tite, or equal hubs for rigid steel conduit.
  6. Use conduit bodies for rigid steel conduit of metal and sized as required by the NEC (NFPA 70-2008). Use Appleton Form 35 threaded Unilets; Crouse-Hinds Mark 9 or Form 7 threaded condulets; Killark Series O Electrolets; or equal, for normal conduit bodies for rigid steel conduit. Where conduit bodies for rigid steel conduit are required to be approved for hazardous (classified) locations, use conduit bodies manufactured by Appleton, Crouse-Hinds, or Killark, or equal.
  7. Use only couplings for rigid steel conduit supplied by the conduit manufacturer.
  8. Use Appleton Type EYF, EYM, or ESU; Crouse-Hinds Type EYS or EZS; Killark Type EY or EYS; or equal, sealing fittings for rigid steel conduit. Where condensate may collect on top of

a seal, provide a drain by using Appleton Type SF Crouse-Hinds Type EYD or EZD, or equal Drain Seal.

9. Use Appleton Type ECDB, Crouse-Hinds ECD, or equal drain fittings for rigid steel conduit.

#### D. Fittings for PVC Conduit

1. Fittings used with PVC conduits shall be of the PVC solvent-weld type and shall be of the same material as the conduit.
2. Expansion fittings shall be provided as recommended by the manufacturer.

#### E. Fittings for PVC Coated Rigid Steel Conduit

1. Fittings with PVC coated rigid steel conduit shall be PVC coated in a manner similar to the conduit. The exterior of the fittings shall be coated with 2-mil thick urethane prior to the application of the 40-mil exterior PVC coat. Interior of the fittings shall have a 2-mil urethane finish. The fittings shall have ribbed finish to assist in the installation of fittings.
2. Thread-less fittings shall not be used with PVC coated rigid steel conduit.
3. Bushings and ground bushings shall be as specified for rigid galvanized steel conduits.

#### F. Fittings for Flexible Metal Conduit

1. Fittings used with flexible metal conduit shall be compression type, cadmium-plated malleable iron body with locknut and bushing
2. Where applicable, 45- and 90-degree fittings shall be used

#### G. Fittings for Liquid-Tight Flexible Conduit

1. Fittings used with liquid-tight conduit shall have cadmium-plated malleable iron body and gland-nut, brass grounding ferrule threaded to engage conduit. These fittings shall also use spiral and "O" ring seals around the conduit, the box connection and insulated throat. The insulated throat connectors for liquid-tight flexible metal conduit of metal will have an integral plastic bushing rated for 105 degrees C, and of the long design type extending outside of the box or other device at least 2-inches.
2. Use Thomas & Betts Super-Tite Nylon Insulated Connectors or equal
3. Where applicable, 45- and 90-degree fittings shall be used

#### H. Raceway Supports

1. General: Raceway support systems shall be designed to provide a factor of safety of no less than five.
2. Conduit Supports: Conduit supports shall be one-hole galvanized malleable iron pipe straps used with galvanized clamp backs and nesting backs where required. When used with PVC coated rigid steel conduit, the conduit supports shall be 40 mils thick PVC coated.
3. Ceiling Hangers: Ceiling hangers shall be adjustable galvanized carbon steel, PVC coated 40 mils thick, pipe hangers. Straps or hangers of plumber's perforated type will not be acceptable. Hanger rods shall be 2-inch minimum galvanized all-thread rod and shall meet or exceed ASTM A193-B7 and ASME Boiler and Pressure Vessel Code specifications. Trapeze, rod type hangers shall not be loaded in excess of 700 pounds per rod. Where loading exceeds this value, rigid frames shall be provided.
4. Racks: Racks shall be constructed from framing channel. Channels and all associated hardware shall be steel, hot-dip galvanized after fabrication of the channel. Field cuts shall be painted with zinc-rich paint. Channels attached directly to building surfaces shall be 14-gage minimum material 1-5/8 inches wide by 13/16 inch deep. All other channels shall be 12-gage minimum material 1-5/8 inch wide by 1-5/8 inch minimum depth. Racks shall be designed to

limit deflection to 1/360 of span. All exposed ends of framing channel shall be covered with manufacturer's standard plastic inserts. The racks shall be PVC coated to 40 mil thickness.

I. Raceway Tags

1. Provide permanent, nonferrous metal markers with raceway designations pressure stamped, embossed, or engraved onto the tag.
2. Tags relying on adhesives or taped-on markers are not acceptable.
3. Attach tags to raceways with noncorrosive wire.

J. Warning Tape:

1. Provide heavy-gauge, yellow plastic tape of 6 -inch minimum width for use in trenches containing electric circuits. Utilize tape made of material resistant to corrosive soil. Use tape with printed warning that an electric circuit is located below the tape. Manufacturers and types: ITT Blackburn Type YT or RT; Griffolyn Co. Terra-Tape; or equal

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. In addition to the provisions of the Division 1 – General Requirements, and Section 16010 "Electrical General Provisions," prior to installation, store all products specified in this section in a dry location.
- B. Minimum Raceway Size: 3/4-inch.
- C. Preparation for pulling in conductors:
  1. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. 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.
  2. Immediately after installation, plug or cap all raceway ends with watertight and dust-tight seals until the time for pulling in conductors.

### **3.02 Installation**

- A. All conduits shall be as specified in Section 1.01B.
- B. Each conduit shall be identified at each end with a permanent non-corrosive metal marker. Designation shall be pressure stamped into the tag. The conduit identification shall be the designated conduit number as shown.
  1. Final Connection to Certain Equipment
    - a. Make final connection to motors, wall or ceiling mounted fans and unit heaters, dry type transformers, valves, local instrumentation, and other equipment where flexible connection is required to minimize vibration or where required to facilitate removal or adjustment of equipment, with 36-inch maximum length liquid-tight, PVC-jacketed, flexible steel conduit.
    - b. The flexible conduit shall be long enough to allow the item to which it is connected to be withdrawn or moved off its base. Use liquid-tight flexible metal conduit in outside areas, process areas exposed to moisture, and areas required to be oil free and dust-tight.
  2. Special Locations:
    - a. Use rigid steel conduit:

- 1) Where conduit changes from underground and/or concrete embedded to exposed
  - 2) Under equipment mounting pads
  - 3) In exterior light pole foundations
3. Communication and Instrumentation Conduits:
- a. GRS for above grade indoor locations.
  - b. PVC-RSC for exposed outdoors and corrosive environments.
- C. Location, Routing, and Grouping:
1. Conceal or expose raceways as indicated. 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. Conduit supports spaced not more than 8 feet apart.
  3. No conduit shall approach closer than 6 inches to any object operating above the rated temperature of its cable temperature.
  4. Conduit supported directly from the concrete structure shall be spaced out at least 1/4 inch using one-hole hot-dip galvanized malleable iron straps with nesting backs or, if three or more conduits are located in a parallel run, they shall be spaced out from the wall approximately 5/8 inch to 1 inch by means of framing channel. Runs of individual conduit suspended from the ceiling shall be supported with galvanized wrought steel pipe hangers. Where three or more conduits are suspended from the ceiling, suitable steel racks shall be constructed subject to submittal to the Engineer for review.
  5. Conduit rack and tray supports shall be secured to concrete walls and ceilings by means of cast-in-place anchors in accordance with the structural section of these specifications. Individual conduit supports may be similar to cast-in-place anchors, die-cast, rustproof alloy expansion shields or cast flush anchors. Wooden plugs, plastic inserts or gunpowder-driven inserts shall not be used as a base to secure conduit supports.
  6. All conduit entering sheet steel boxes or cabinets shall be secured by locknuts on both the interior and exterior of the device and shall have an insulating bushing constructed over the conduit end. All conduit entering NEMA 12 boxes shall be terminated with a rain-tight hub having an insulated liner. All surface mounted cast boxes and plastic enclosures shall have threaded hubs. All joints shall be made with standard threaded couplings or specified unions. Metal parts of plastic control stations and coated boxes shall be bonded to the conduit system. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any conduit. The ends of all conduits shall be cut square, reamed and threaded with straight threads. Rigid steel conduit shall be made up tight and without thread compound. Male threads on rigid steel conduit shall be coated with electrically conductive zinc rich paint. Threading shall be done with dies, with the guide sleeve bored out to allow for increased diameter or the PVC coated conduit. Conduit shall be made with the next larger bend or next larger shoe bushed for proper fit.
  7. Avoid obstruction of passageways. Run concealed raceways with a minimum of bends in the shortest practical distance considering the building construction and other systems.
  8. In block walls, do not run raceways in the same horizontal course with reinforcing steel.
  9. 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.

10. Paint all threads of galvanized conduits with UL approved zinc-rich paint or liquid galvanizing compound before assembling. Touch up after assembly to cover nicks or scars.
11. Do not notch or penetrate structural members for passage of raceways except with prior approval of the Engineer or the Inspector.
12. Do not run raceways in equipment base foundations.
13. Locate above ground raceways concealed in poured concrete so that the minimum concrete covering is not less than 1-1/2-inches.
14. Except at raceway crossings, separate raceways in slabs not less than six times the raceway outside diameter
15. 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.
16. Install concealed, embedded, and buried raceways so that they emerge at right angles to the surface. Provide support during pouring of concrete to ensure that raceways remain in position.
17. Allow a minimum of 7 feet headroom for conduit passing over walkways.
18. Communication and instrumentation conduits crossing power circuits shall be separated from such circuits by the minimum distance stipulated by the IEEE standards.
19. Welding, brazing or otherwise heating of the conduit is not allowed. Plumber's perforated tape shall not be used for any purpose.
20. Where required for ease of pulling and as necessary to meet code, the Contractor shall provide cast junction or pullboxes even though not shown on the drawings. The Contractor shall limit the number of equivalent 90-degree bends to three in any run between pull boxes. Runs shall be limited to 400 feet, less 100 feet for each equivalent 90-degree bend in the run. Bends and offsets shall be avoided where possible, but where necessary, shall be made with an approved hickey or conduit bending machine, or shall be factory preformed bends.
21. All conduit entering sheet steel boxes or cabinets shall be secured by locknuts on both the interior and exterior of the device and shall have an insulating bushing constructed over the conduit end. All conduit entering NEMA 12 boxes shall be terminated with a rain-tight hub having an insulated liner. All surface mounted cast boxes and plastic enclosures shall have threaded hubs. All joints shall be made with standard threaded couplings or specified unions. Metal parts of plastic control stations and coated boxes shall be bonded to the conduit system. Running threads shall not be used in lieu of conduit nipples, nor shall excessive thread be used on any conduit. The ends of all conduits shall be cut square, reamed and threaded with straight threads. Rigid steel conduit shall be made up tight and without thread compound. Male threads on rigid steel conduit shall be coated with electrically conductive zinc rich paint. Threading shall be done with dies, with the guide sleeve bored out to allow for increased diameter or the PVC coated conduit. Conduit shall be made with the next larger bend or next larger shoe bushed for proper fit.
22. Conduit constructed in concrete slabs or walls shall be placed in the middle third of the slab or wall. Conduit rising through a slab shall be protected by a formed concrete pad approximately 6 inches in diameter and 4 inches above the finished floor or the conduit shall come up through the equipment pad. Clearances equal to the conduit trade diameter, but not less than 1-1/2 inches, shall be maintained between conduits encased in slabs. Clearances of less than 1-1/2 inches at conduit crossing and terminating locations may be allowed at the discretion of the Engineer.
23. Flexible conduit shall not be used as a general purpose raceway but shall be provided in locations requiring flexibility with the approval of the Engineer.

24. Liquid-tight conduit shall be used for all motor connections as detailed. Where flexibility is required for electrical raceways on equipment, liquid-tight conduit shall be used in accordance with JIC standards, these specifications, and the local codes. The maximum length of flexible, liquid tight conduit shall be 36-inches. The terminating fitting and sealing shall be as shown in the motor details.
25. The Contractor shall exercise the necessary precautions to prevent the lodging of dirt, concrete or trash in the conduit, fittings and boxes during the course of construction.

D. Support:

1. Support raceways at intervals not exceeding NEC requirements unless otherwise indicated. Support multiple raceways adjacent to each other by ceiling trapeze. Support individual raceways by wall brackets, strap hangers, or ceiling trapeze, fastened by toggle bolts on hollow masonry units, expansion shields on concrete or brick, and machine screws or welded thread studs on steelwork.
2. Threaded studs driven in by a powder charge shall not be accepted.
3. Support all raceways from building structural members only.
4. Do not use nails anywhere or wooden plugs inserted in concrete or masonry as a base for raceway or box fastenings. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

E. Bends:

1. Make changes in direction of runs with symmetrical bends. Make bends and offsets of the longest practical radius. 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 and of neat appearance. Make field bends in parallel runs.
3. For PVC 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 90 degrees or allowable bending radius of the cable to be installed or that significantly restricts the conduits flexibility.

F. Bushing and Insulating Sleeves:

1. Where metallic conduit enters metal equipment enclosures through conduit openings, install a bonding bushing on the end of each conduit. Install a bonding jumper from the bushing to any equipment ground bus or ground pad.
2. If neither exists, connect the jumper to a threaded bolt connection to the metallic enclosure.
3. Use manufacturer's standard insulating sleeves in all metallic conduits or insulated bushings terminating at an enclosure.

G. Expansion Joints:

1. Provide suitable expansion fittings for raceways crossing expansion joints in structures or concrete slabs, or provide other suitable means to compensate for expansion and contraction.
2. 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.

H. PVC Conduit:

1. Solvent weld PVC conduit joints with solvent recommended by the conduit manufacturer. Follow manufacturer's solvent welding instructions and provide watertight joints.
2. Use acceptable PVC terminal adapters when joining PVC conduit to metallic fittings.

3. Use acceptable PVC female adapters when joining PVC conduit to rigid metal conduit.
- I. PVC Coated Rigid Steel Conduit:
1. Install in strict accordance with the manufacturer's Instructions.
  2. Touch up any damage to the coating with conduit manufacturer acceptable patching compound.
  3. PVC boot shall cover all threads.
  4. Where belled conduits are used, bevel the un-belled end of the joint before joining. Leave no metallic threads uncovered.
  5. PVC coated conduit shall be tightened, with strap wrenches, and the plastic overlap shall be coated and sealed in accordance with the manufacturer's recommendations. Pipe wrenches and channel locks shall not be used for tightening plastic coated conduits. All damaged areas shall be patched, using manufacturer's recommended material. The area to be patched shall be built up to the full thickness of the coating. Joints in multiple conduit runs shall be staggered.
  6. Threading:
    - a. Plasti-Bond can be threaded with any standard threading tool. Larger model power threaders with open die heads require no modification beyond optional grip inserts for PVC coated conduit.
    - b. If a threader with a tight-fitting die head is to be used, like many hand-held models, it is necessary to machine out the interior diameter of the stationary guide approximately 12/100ths of an inch to allow for clearance of the PVC coating. Prior to machining the pipe guide take note of the sequence in which the dies are removed; then replace dies in the proper sequence.
    - c. If conduit is to be threaded manually it must be pencil cut before threading to enable the die teeth on the threader to engage the conduit. In the same manner as sharpening a pencil with a knife, cut away 1/4" of the exterior coating from the end to be threaded. This allows the pipe guide to ride up and over the PVC coating enabling the removal of the coating and threading in one operation.
    - d. Before threading, by any method, a series of cuts should be made in the PVC coating along the longitudinal axis of the conduit. The thread protector attached to one end of the conduit can be used to gauge the length of the cuts. Make a slit up one side of the thread protector with a knife and remove it from the conduit. Push the thread protector over the cut end of the conduit to be threaded and place a mark on the PVC coating at the end of the protector. With a knife, cut around the circumference of the conduit at the mark, through the PVC coating, to the metal. This cut will indicate the starting point for the longitudinal cuts and it will give an even ending to the PVC coating removed during threading. The longitudinal cuts will allow the PVC coating to be removed in small pieces instead of long strips that can foul the die head causing the conduit to collapse.
    - e. Use a good quality thread cutting oil to flush away the metal and PVC chips. After threading use a degreasing spray to thoroughly clean the threads and the interior of the pipe. Use care not to contaminate the cutting oil with the degreasing spray. Degreasing is important in order to insure that the touch up compound will adhere to the unprotected steel. Bare steel is the most vulnerable area to corrosion in any conduit system, therefore, touch up compound must be used on all field cut threads and internal reams. These specially formulated interior and thread touch-up compounds are available in 4 ounce and quart cans. When an access fitting or coupling is attached to the newly threaded conduit a

colored band red for Plasti-Bond), will form at the end of the sleeve. This indicates proper installation procedures have been followed

J. Penetrations:

1. Seal the interior of all raceways entering structures at the first box or outlet with electrical duct sealant per NEC 505.17, (D)(2) to prevent the entrance into the structure of gases, liquids, or rodents.
2. Dry pack with non-shrink grout around raceways that penetrate concrete walls, floors, or ceilings aboveground, or use one of the methods specified for underground penetrations.
3. Where an underground conduit enters a structure through a concrete roof or a membrane waterproofed wall or floor, provide an acceptable, malleable iron, watertight, entrance sealing device. When there is no raceway concrete encasement specified or indicated, provide such a device having a gland type sealing assembly at each end with pressure bushings which may be tightened at any time. When there is raceway concrete encasement specified or indicated, provide such a device with a gland type sealing assembly on the accessible side. Securely anchor all such devices into the masonry construction with one or more integral flanges. Secure membrane waterproofing to such devices in a permanently watertight manner.
4. Wherever conduits penetrate concrete wall panels to outdoors or as shown, the Contractor shall detail the required mountings. He shall locate and use a galvanized pipe sleeve for passage of the conduit. A compression type seal shall be used to form a complete watertight installation. The installation design shall be submitted to the Engineer.
5. Where an underground raceway without concrete encasement enters a structure through a non-waterproofed wall or floor, install a sleeve made of Schedule 40 galvanized pipe. Fill the space between the conduit and sleeve with a suitable plastic expandable compound, or an oakum and lead joint, on each side of the wall or floor in such a manner as to prevent entrance of moisture. A watertight entrance sealing device as specified may be used in lieu of the sleeve.
6. Where raceways penetrate fire-rated walls, floors, or ceilings, fire stop openings around electrical penetrations to maintain the fire-resistance rating
7. Raceways passing through roofs shall be flashed.
8. Provide conduit seals where required by Article 500 of the NEC.

K. Underground Conduits, Direct Burial raceways:

1. Unless otherwise indicated, all underground conduits shall PVC coated rigid steel.
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. Do not use union type fittings underground.
5. Provide a minimum cover of 2-feet over all underground raceways unless otherwise indicated. Warning tape as specified in Article 2.11A shall be placed no less than 12 inches above conduit and duct bank.
6. Do not backfill underground direct burial raceways until they have been inspected by the Engineer.

7. Warning Tapes: Bury warning tapes approximately 8-inches below grade and above all underground conduit runs or duct banks. Align parallel to and within 12-inches of the centerline of runs.
8. When the contract drawings indicate underground PVC conduits then a transition shall be provided. The transition shall be made from PVC Schedule 80 conduit to PVC coated rigid galvanized steel conduit at all stub-ups and when entering equipment. The transition shall consist of a PVC coated rigid galvanized conduit. Conduits shall be laid with a minimum grade of 2 inches per 100 feet from structure to manhole or from high point to manholes.
9. Ducts shall be of the dimensions and materials and with reinforcing as shown. They shall have a uniform continuous slope with no low points to entrap water. All duct runs shall be placed on an undisturbed excavated soil base wherever possible. Where duct runs pass through backfilled areas, the soil base shall be a backfill of loam, placed in layers. Each layer shall be solidly tamped or rolled, as required, to obtain complete compaction to the elevation and pitch of the bottom of the duct run shown. The compaction shall be as specified in the structural section of these specifications.
10. Plastic spacers shall be manufactured by the conduit supplier and shall be located 5 feet on centers. Wire ties shall be made at each spacer location and shall be securely anchored. Duct runs shall be watertight. When the termination of duct is not detailed on the duct run drawing, a coupling shall be installed.
11. The ends of all conduits shall be suitably plugged, capped and protected from damage during construction. Ends of conduits which are not to be used for long periods shall be protected from dirt, rodents, etc., by plugging at the ends with manufactured plugs. A non-setting compound may be used on the plug to make it adhere to the conduit end. A 1/4-inch hole shall be drilled in the lower portion of the plug to provide drainage of the plugged conduit.
12. A No. 5/8 mule tape shall be pulled through each high voltage, 480-volt power feeder, and branch feeder conduits as the conduit sections are laid and the tape shall be securely fastened at each end of the finished duct run. When ducts are reserved for future use, the mule tape shall also be used and secured.
13. A mule tape shall always be attached to the rear end of the swab or mandrel to replace the wire being pulled out. When not in use, this tape shall be securely fastened at both ends of the duct.
14. Each conduit in a manhole, handhole, or pull box shall be identified with a stamped aluminum or brass tag bearing the conduit number. The tags shall be permanently attached to conduits by means of 316 stainless steel or nylon tie wrap. Install conduit couplings and cap ends of all spare underground conduits at each handhole/manhole.
15. Each conduit shall be identified at each end with a permanent non-corrosive metal marker. Designation shall be pressure stamped into the tag. The conduit identification shall be the designated conduit number as shown.
16. Separation and Support:
  - a. Separate parallel runs of two or more 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 10-feet.
  - b. Support raceways installed in fill areas to prevent accidental bending until backfilling 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.
17. Arrangement and Routing:

- a. Arrange multiple conduit runs substantially in accordance with any details shown on the Drawings. Locate underground conduits where indicated on the Drawings.
- b. 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, refer the condition to the Engineer for instructions before further work is done.
- c. Where other utility piping systems are encountered or being installed along a raceway route, maintain a 12-inch minimum vertical separation between raceways and other systems at crossings. Maintain a 12-inch minimum separation between raceways and other systems in parallel runs. Do not place raceways over valves or couplings in other piping systems. Refer conflicts with these requirements to the Engineer for instructions before further work is done.
- d. Provide insulated grounding bushings on all metallic raceways entering manholes. Provide bell-ends flush with manhole walls on all nonmetallic raceways entering manholes.
- e. In multiple conduit runs, stagger raceway coupling locations so that couplings in adjacent raceways are not in the same transverse line.
- f. Provide markers at grade to indicate the direction of underground conduits provided under this Contract. Provide markers consisting of double-ended arrows, straight for straight runs and bent at locations where runs change direction. Provide markers at all bends and at intervals not exceeding 100-feet in straight runs. Use markers made of sheet bronze not less than 1/4-inch thick embedded in and secured to the top of concrete posts. Use markers not less than 10-inches long and 3/4-inch wide and marked ELECTRIC CABLES in letters 1/4-inch high incised into the bronze to a depth of 3/32-inch.
- g. All conduits shall enter maintenance holes and structures at right angles.

18. Raceway Coating:

- a. At couplings and joints, coat metallic underground direct-burial conduits with Koppers Bitumastic No. 505 or equal, or wrap with Scotchwrap No. 51, or equal plastic tape with 1/2-inch overlap.

19. Direct Earth Burial Conduit Zone Backfill Installation:

- a. Backfill material for the conduit zone of direct burial conduit trenches may be selected from the excavated material if it is free from roots, foreign material, and oversized particles.
- b. Use material with 3/4-inch maximum particle size and suitable gradation for satisfactory compaction. Remove material if necessary to meet these requirements.
- c. Imported 3/4-inch minus gravel or sand may be used in lieu of material from the excavation.
- d. 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.

20. Backfill Installation above Conduit Zone of Direct Burial Conduit:

- a. Unless otherwise required in Section 0200 "Earthwork", Backfill material above the conduit zone of direct burial 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. 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 ASTM D 1557.

L. Wireways:

1. Mount wireways securely in accordance with the LAEC and manufacturer's instructions. Locate removable cover or hinged cover on accessible vertical face of wireway unless otherwise indicated.

M. Empty Raceways

1. Certain raceways will have no conductors pulled in as part of this Contract. Identify with tags at each end and at any intermediate pull point the origin and destination of each such empty raceway. Where a raceway has been identified with a name (number) in the Raceway Schedule, use that name on the tag in lieu of origin and destination. Provide a removable permanent cap over each end of each empty raceway. Mandrel and provide a nylon pull cord in each empty raceway.

N. Firestops:

1. The Contractor shall furnish adequate firestops and seals for cables, conduits, trays, and wireways, etc., passing through building floors or wall openings.
2. Products which utilize intumescent compounds capable of being leached out by water shall not be used.
3. Flamenastic 71A, Vimasco No. 1-A, or equal, shall be used for this purpose and shall be applied in accordance with manufacturer's recommendations.

O. Painting

1. Paint raceway systems in accordance with and as specified in Section 09900 - Protective Coating Systems.

**3.03 Field Quality Control**

- A. Provide raceway systems meeting or exceeding the requirements of the NEC.

**3.04 Adjusting / Cleaning / Protection**

- A. 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.

**\*\*END OF SECTION\*\***

**SECTION 16115  
JUNCTION AND DEVICE BOXES AND FITTINGS**

**PART 1 - GENERAL**

**1.01 Summary**

- A. Scope: This section provides specifications for all electrical junction boxes, device boxes, fixture support boxes, floor boxes, terminal cabinets and fittings.
- B. Type: Unless otherwise listed, all junction boxes, device boxes, fittings, etc., shall be hot-dip galvanized cast ferrous alloy type. All exposed boxes and fittings shall be PVC coated.

**1.02 References**

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
ANSI C80.1	Electrical Rigid Steel Conduit
UL 1	Flexible Metal Conduit
UL 5	Surface Metal Raceway and Fittings
UL 6	Electrical Rigid Metal Conduit – Steel
UL 514B	Conduit, Tubing and Cable Fittings
UL 651	Schedule 40 and 80 Rigid PVC Conduit and Fittings
NEMA RNI-2005	PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC-2-2003	Electrical PVC Tubing and Conduit
NEMA TC-3-2004	PVC Fittings for Use With Rigid PVC Conduit and Tubing

**1.03 Submittals**

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

**1.04 Quality Assurance**

- A. The boxes and fittings shall be premium quality suitable for installation in a Water Facility.

**1.05 Project / Site Conditions**

- A. The boxes and fittings will be installed in a Water Facility. Ambient temperatures are expected to range between 10 degrees F and 115 degrees F. Relative humidity may be expected to fluctuate between 10 percent and 100 percent.

**PART 2 - PRODUCTS**

**2.01 Equipment and Materials**

- A. Junction boxes; device boxes; fixture support boxes; and oblong, round and rectangular conduit fittings shall be hot-dip galvanized cast ferrous alloy. Integrally cast threaded hubs or bosses shall

be provided for all conduit entrances and shall provide for full 5-thread contact on tightening. Drilling and threading shall be done before galvanizing. The cover plate shall be of similar hot-dip galvanized cast ferrous alloy material. A full body neoprene gasket and Type 316 stainless steel screws shall be provided for all covers. Hubs for connection of conduit to sheet steel junction, device or terminal boxes shall be made of cast ferrous alloy, electroplated with zinc, and shall have insulating bushings. The hubs shall utilize a neoprene "O"-ring and shall provide a watertight connection.

- B. Outlet and Switch Boxes: Outlet and switch boxes shall be FS or FD boxes as manufactured by Crouse-Hinds, Appleton, or equal. Boxes shall be provided with blank covers for all unused openings.
- C. Ganged Boxes: Outlet and device boxes shall be ganged where two or more devices are located together. Device covers shall be ganged for gang boxes and shall be gasketed with suitable neoprene gaskets to fit the devices and box used.
- D. Sheet Steel Boxes: Boxes larger than FD boxes shall be fabricated from code gage steel, finished inside and out as specified for terminal cabinets. Before finish is applied, a grounding pad drilled for two bolted grounding lugs or a grounding stud shall be welded to the inside of the box. All hardware shall be Type 316 stainless steel. Boxes shall, as a minimum, meet NEMA 12 and JIC requirements and shall be NEMA 4 where exposed to the weather or dripping water.
- E. Boxes in Corrosive Areas: Boxes and fittings located in corrosive areas shall be NEMA 4X. This material shall be fiberglass reinforced polyester with minimum properties as follows:
  - 1. Compressive strength: 28,000 psi
  - 2. Flexural strength: 15,000 psi per ASTM D790 and D675
  - 3. Tensile strength: 12,000 psi per ASTM D638
  - 4. Flame-resistant and self-extinguishing per ASTM D635
- F. All conduit entries shall use ferrous alloy hubs with 40 mil epoxy coating. All conduit entering plastic boxes and any exposed metal on plastic boxes which is not isolated from the interior of the box shall be bonded together with a suitable grounding conductor. Corrosive areas shall be as noted in Section 16010 and/or as shown on the drawings.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Outlet and switch boxes shall be located to provide ample clearance between fixtures and pipes, beams and ducts. The location shall be verified on the job to avoid conflict with other work. Boxes shall be accurately placed and shall be independently and securely supported. Wooden plugs inserted in masonry or concrete shall not be used as a base to secure boxes nor shall welding or brazing be used for attachment. Boxes shall be secured by galvanized brackets, expansion bolts, toggle bolts, or machine or wooden screws depending on the type of construction. Unless otherwise indicated, receptacle boxes shall be mounted 12 inches above the floor in offices and similar areas and 48 inches above the floor in all other areas. Switch boxes shall be mounted 48 inches above the floor.
- B. Boxes in corrosive atmospheres or wet locations shall be PVC or PVC coated cast steel with threaded hubs.

**\*\*END OF SECTION\*\***

**SECTION 16120**  
**WIRE AND CABLES, 600 VOLTS AND BELOW**

**PART 1 - GENERAL**

**1.01 Summary**

- A. Scope: This section provides specifications for all wire and cable used for electrical current conductors.
- B. Type: All conductors shall be copper, type B stranded, unless otherwise noted. The minimum size of conductors shall be No. 12 AWG.

**1.02 References**

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
ICEA S-61-402/NEMA WC-5	Thermoplastic - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
ICEA S-19/NEMA WC-3	Rubber - Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
S-68-524/NEMA WC-7	Cross Linked Thermosetting Polyethylene Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
S-68-516/NEMA WC-8	Ethylene Propylene Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NFPA	National Fire Protection Association
UL 62	Flexible Cord and Fixture Wire
UL 83	Insulated Wires and Cables
UL 486A	Wire Connectors and Soldering Lugs for use with Copper Conductors
UL 486B	Wire Connectors for use with Aluminum Conductors
UL 510	Insulating Tape
UL 1277	Electric Power and Control Tray Cables with Optical Fiber Members
UL 1449	Safety Transient Voltage Surge Suppressors
NEMA WC-55	Instrumentation Cables and Thermocouple Wire
NEMA WC-57	Control Cables
ASTM B8	Standard Specifications from Concentric Lay Standard Copper Conductors, Hard, Medium-Hard or Soft
Title 8	Industrial Relations, Subchapter 5, Electrical Safety Orders, California Code of Regulations

### **1.03 Definitions**

- A. Cable: Multi-conductor, insulated, with outer sheath.
  - 1. May contain either building wire or instrumentation wire
- B. Instrumentation Cable: Multiple conductors, insulated, twisted with outer sheath, intended for transmission and distribution of low current (4-20 mA DC) or low voltage (0-10 V DC) analog signals, No. 16 AWG and smaller. Commonly used types are defined in the following:
  - 1. TWP: Twisted pair without shield.
  - 2. TWSP or TSP: Twisted shielded pair.
  - 3. TWST: Twisted-shielded triad.
- C. Wire: Single conductor, insulated, with or without outer jacket depending upon type

### **1.04 Submittals**

- A. The Submittals shall comply with the provisions set forth in Sections 01300 and 16010.
- B. Shop Drawings shall include:
  - 1. Product technical data including:
    - a. Acknowledgement that submitted products meet requirements of standards
    - b. Catalog cuts and other brochures depicting conductor characteristics
    - c. Manufacturer's recommended splicing, testing, and installation procedures and practices and Manufacturer's installation instructions
  - 2. Manufacturer's certified test records, factory test procedures and test Reports.
  - 3. Samples
- C. Field testing using attached Cable Test Data Form, HI-POT and Megger tests including certified test reports. Also, include splicing personnel qualifications.

### **1.05 Quality Assurance**

- A. The wire and cable shall be of premium quality suitable for installation in Water facilities.
- B. All Conductors furnished by the Contractor shall be listed by and shall bear the label of Underwriters' Laboratories, Incorporated, (UL).
- C. The construction and installation of all electrical equipment and materials shall comply with all provisions of the CAL OSHA Safety Orders Title 8 CCR, as applicable), State Building Standards, and applicable local codes and regulations

### **1.06 Delivery, Storage, and Handling**

- A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Owner's Representative, secure from weather or accidental damage.

### **1.07 Project / Site Conditions**

- A. The wire and cable will be installed in raceways in a water facility. Ambient temperatures are expected to range between 10 degrees F and 115 degrees F. Relative humidity is expected to range from 10 percent to 100 percent.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired only. Products of other manufacturers will be considered in accordance with the General Requirements.
- B. Building wire, power and control cable:
  - 1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    - a. Alpha Wire Corporation
    - b. American Insulated Wire Corporation
    - c. Belden Wire and Cable
    - d. Carol Cable Company
    - e. General Cable
  - 2. Conform to UL 444, Communications Cable, NEC type CMP, tinned copper conductors, 100 percent shield coverage, single TSP, Teflon insulated with Teflon jacket in all applications except small diameter.
  - 3. Multiple conductor, small diameter instrumentation cable shall be used where existing conduits limit conduit space as called out on drawings:
    - a. Plenum type single or multi paired, twisted pairs, overall shield with drain wire
    - b. FEP or FPR insulation and jacket
    - c. Moisture and flame resistance
    - d. Jacket thickness 0.015 IN minimum
    - e. Maximum outside diameter:
      - 1) 1 PR – 0.125 IN
      - 2) 2 PR – 0.180 IN
  - 4. Telephone cable:
    - a. Solid conductors, tinned copper, No. 24 AWG
    - b. 150 volt, vinyl insulated
    - c. UL listed 2576

### **2.02 Equipment and Materials**

- A. Unless otherwise indicated, provide stranded conductors, except provide solid conductors where No. 10 AWG and No. 12 AWG are designated for branch circuit power wiring in lighting and receptacle circuits.
- B. For all direct burial and aerial conductors and cables, provide conductors with UL labeling "TYPE USE" and RHW insulation with heavy-duty, black, neoprene sheath meeting the physical requirements and minimum thickness requirements of ICEA S-19-81 and NEMA WC 3.
- C. Where flexible cords and cables are specified, provide Type SO, 600-volt, with the number and size of copper conductors indicated.
- D. Insulation

1. All conductors shall be rated at 600 Volts unless noted otherwise within this specification section.
2. All wiring shall be type XHHW-2 unless otherwise noted within this specification section.
3. All conductors shall be sized for operation at 75 degrees C maximum operating temperature.
4. For power conductors, provide all single conductors and individual conductors of multi-conductor power cables with integral insulation pigmentation of the designated colors, except conductors larger than No. 6 AWG may be provided with color coding by applying a heat shrink tube of the appropriate color.

#### E. Conductors

1. Unless specifically noted otherwise herein, all conductors for general wiring shall be a minimum of 98% conductivity, stranded, soft drawn copper. Aluminum or aluminum alloys are not acceptable.
2. 120 Volt control, indicator, signal and metering conductors may be #14 AWG, and shall be stranded.

#### F. Instrumentation Signal Cables

1. Instrumentation signal cables shall be of the type used for process control with twisted shielded pairs or triads with polyvinyl jacket an overall shield over the multiple pairs or triads.
2. The instrumentation cable shall be rated 600 Volts at 90 degrees C or better.
3. The size of the instrumentation cable shall be AWG No. 16 with seven strands minimum.
4. All instrumentation cables shall be UL listed. Belden 8719 (Pairs), Belden 8618 (Triads) or equal.

#### G. PLC Communications Cables

1. Communication cables for remote I/O connections and for PLC high speed data communications shall be as recommended by the manufacturer of the PLC equipment.

#### H. Ethernet Communications Cables

1. Ethernet communication cables shall be Industrial Grade Cat 6, Unshielded Twisted Pair (UTWP) for building interiors, Belden DataTuff or equal
2. Ethernet communication cables shall be Industrial Grade gel filled outdoor rated Cat 6, Unshielded Twisted Pairs for site and building exteriors and no more than 50 feet into building interiors, Belden DataTuff or equal

#### I. Portable Cable:

1. Cord shall be NEMA Type SOW-A flexible cord rated at -50 deg C to 105 deg C. All cords shall contain an equipment grounding conductor. Cord shall be rated for use as a fully submersible cable.
2. Conductors: Bunch or rope stranded, uncoated annealed copper conforming to UL and CSA requirements. A suitable separator is applied over the conductor.
3. Insulation: Ethylene Propylene (EPDM) conforming to UL Standard 1581 and CSA requirements. Minimum average wall thickness is 45 mils for 14 AWG, 12AWG, and 10 AWG; and 50 mils for sizes 8 AWG through 2 AWG.
4. Color code: Insulation colored as follows:
  - a. 2 Conductors - Black, White
  - b. 3 Conductors - Black, White, Green

- c. 4 Conductors - Black, White, Red, Green
- d. 5 Conductors - Black, White, Red, Green and Orange
- 5. Cable assembly: The applicable number of insulated conductors are cable together with elastomeric fillers, as necessary, and with a suitable lay.
- 6. Jacket: Black or Yellow special thermosetting compound conforming to UL and CSA requirements.
- 7. Marking: Jacket surface is printed in accordance with requirements of UL, CSA and MSHA.
- 8. Portable cord for supply to permanent installations, such as pumps, cranes, hoists and portable equipment shall have a wire mesh cord grip of flexible stainless steel wire to take the tension from the cable termination. Weatherproof strain relief fittings shall be used for all connections. To prevent unnecessary strain on cords, 45-degree and 90-degree connectors shall be used where applicable. Flexible cords feeding submersible non-wicking neoprene construction.
- 9. Manufacturer shall be American Mustang, York Wire & Cable or equal.

J. VFD Cable:

- 1. The cable shall be 600V/1000V rated, with stranded tinned copper conductors, shielded, suitable for use with Variable Frequency Drives.
- 2. The insulation shall be rated 90 degrees Celsius Wet/Dry operating temperature.
- 3. Terminations shall have rating that are at least equal to those of the cable.
- 4. The conductor shall be annealed stranded tinned copper per ASTM B3, B8 and B33.
- 5. The insulation shall have a minimum average wall thickness of 30 mils with the insulation mater XLPE with a XHHW-2 listing per UL 44. The insulated conductors shall be cabled together with a minimum of one ground wire with a minimum circular mil area equivalent to one circuit conductor. Fillers shall be included as necessary to make the cable round.
- 6. The cabled assembly shall be shielded with helically two 2-mil copper tapes that provide 100% coverage over the assembly or with a a 80% minimum coverage tinned copper braid shield used in conjunction with an Aluminum foil shield tape.
- 7. All cables shall have a continuous overall outer sheath of polyvinyl chloride suitable for 90 degree Celsius use.
- 8. Manufacturer shall be Belden VFD cable, Lapp Group Olflex VFD, Lapp Group Olflex VFD Symmetrical or equa.

K. Control Cable:

- 1. Control cable shall be Type SO extra flexible and shall consist of No. 16 copper conductors insulated for 600 volt service. The overall jacket shall consist of 7/64-inch neoprene minimum. The number of conductors shall be as shown on the drawings.

L. Grounding Wire

- 1. Ground wires, no. 1/0 AWG or larger tinned stranded bare copper cable. All smaller ground wires shall be insulated with green color insulation.

## 2.03 Components and Accessories

A. Connections

1. Wire nuts for joints, splices and taps for conductors #8 and smaller shall consist of a cone shaped expandable coil spring insert, insulated with a teflon or plastic shell. Threaded or crimp types will not be accepted. Use "Skotchlock", "Hydent", or equal.
2. Terminals for stranded conductors #8 and smaller shall be a pre-insulated crimp type.
3. Lugs and connectors for conductors #6 and larger shall be compression types of one piece tubular construction with flat rectangular tongues. Two hole lugs shall be used for sizes 4/0 and larger. Fittings for copper conductors shall be tin-plated copper.

#### B. Wire and Cabling Termination and Splicing

1. Subject to compliance with Contract Documents, the following manufacturers are acceptable.
  - a. Burndy Corporation
  - b. Ideal
  - c. Minnesota Mining and Manufacturing Co
  - d. Penn Union
  - e. Thomas and Betts
  - f. Or Equal
2. Splicing of cables and wires in the manholes and handholes shall be kept at a minimum. Where it is possible to pull cables or wires directly through the manholes or handholes, splicing shall be moisture-proof and encapsulated using insulating sealing compound. Splicing kits similar to 3M Company 82A or 8500 Series shall be utilized.

#### C. Labeling

1. Provide complete power and control conductor identification system so that after installation, circuits can be easily traced from origin to final destination.
2. Conductor labels shall be white PVC tubing with machine printed black marking. Tubing shall be sized to fit conductor insulation. Adhesive strips are not acceptable. Machine printed markings, directly on conductors, will be accepted. Panduit, Thomas & Betts, or equal.
3. Tag conductors using a three-segment conductor numbering scheme which defines the origin of the conductor, the function of the conductor, and the destination of the conductor.
  - a. Example: MCCA-P-MCCB where MCCA is the origin, P is the function identification (P = power, C = control, S = signal, etc.), and MCCB is the destination.
  - b. For conductors with one point of origin and two or more destinations, expand the function identification number, e.g., PA, PB, etc.
  - c. Make the origin and destination identification the specific names for the equipment used in the Contract Documents. Make the instrumentation and control identification names exactly as designated, i.e., FT-S-121.
4. Sleeves shall be yellow or white tubing, sized to fit the conductor insulation, with machine printed black marking capable of accepting 24 machine printed character per sleeve label. Adhesive strips are not acceptable.

#### D. Pulling Lubricant

1. All cables shall be properly coated with pulling compound recommended by the cable manufacturer before being pulled into conduits so as to prevent mechanical damage to the cables during installation.
2. Other lubricants to be substituted must be accompanied by a statement from the cable manufacturer as to its acceptable use with the cable being installed.

## E. Electrical Tape

1. Pressure sensitive vinyl
2. Premium grade
3. Heat, cold, moisture, and sunlight resistant
4. UL listed
5. Thickness, depending on use conditions: 7, 8.5. or 10 mil
6. For cold weather or outdoor location, tape must also be all-weather rated
7. Comply with UL 510

### 2.04 Fabrication

- A. Electrical conductors shall be delivered to the job site plainly marked or tagged on 24 inch centers as follows:
1. Underwriters' Label
  2. Gauge
  3. Voltage
  4. Kind of Insulation
  5. Name of Manufacturer
  6. Trade Name

### 2.05 Source Quality Control

- A. Phase A, B, C implies the direction of positive phase rotation.

## PART 3 - EXECUTION

### 3.01 Examination

### 3.02 Preparation

- A. Color Coding and Labeling. Provide color coding throughout the entire network of feeders and circuits (600 volts and below) as follows:

<u>DESCRIPTION</u>	<u>PHASE/CODE LETTER</u>	<u>WIRE OR TAPE COLOR</u>
480 V, 3 PHASE	A	BROWN
	B	ORANGE
	C	YELLOW
208/120 V, 3 PHASE, 4 WIRE	A	BLACK
	B	RED
	C	BLUE
240/120V, 3 PHASE. 4 Wire	A	BLACK
	B	ORANGE (if High Leg)

<u>DESCRIPTION</u>	<u>PHASE/CODE LETTER</u>	<u>WIRE OR TAPE COLOR</u>
	C	BLUE
240 / 120 V, 1 PHASE	L1	BLACK
	L2	RED
120 VAC UPS POWER	L1	ORANGE
DC CONTROL		LIGHT BLUE
NEUTRAL	N	WHITE
GROUND	G	GREEN
SHIELDED PAIR	+	BLACK
	-	CLEAR
PLC DI AND DO, 120 VAC		BLUE (NOTE 1)
<b>LOW VOLTAGE CONTROL</b>		<b>VIOLET (NOTE 2)</b>

Note 1 - Low voltage control electrically direct connected to PLC DI or DO points. Only the wire between the PLC DI or DO and its first landing point shall be BLUE. Wire between this point and other terminations or field devices shall be VIOLET.

Note 2 - Low voltage control not electrically direct connected to PLC DI or DO points. Low voltage includes 120 volts AC or DC and below. Control wiring includes wires, which follow control devices such as switches, or relays and which are not directly connected to power sources, fuses or circuit breakers.

- B. In addition to color coding, all power, control, and alarm wiring shall be numbered and identified by means of wire markers at all service pedestals, motor control centers, panelboards, auxiliary gutters, junction boxes, pull boxes, receptacle outlets, light outlets, manholes, disconnect switches, and circuit breakers. These markers shall correspond to numbers on shop drawings, wiring diagrams and interconnection wiring diagrams. Wire markers shall consist of machine engraved numbers applied by an approved marking device.
- C. Care shall be exercised in pulling wire and cable into conduit or trays so as to avoid kinking, putting undue stress on the cables, or otherwise abrading them. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii. No grease will be permitted in pulling wire or cable. Where pulling compound is used, use only UL listed compound compatible with the cable outer jacket and with the raceway involved. contractor shall perform and submit pulling calculation per manufacturers recommendation to ascertain that there is no overstrain to the cable. The raceway construction shall be complete and protected from the weather before cable is pulled into it.
- D. Single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations shall be wrapped together by arc and fireproofing tapes, and shall be bundled throughout their exposed length with nylon, self-locking, releasable, cable ties placed at intervals not exceeding 18 inches on centers.
- E. Incoming wire in service pedestals, panels, and motor control centers, No. 6 AWG and smaller, shall be bundled and laced at intervals not greater than 6 inches, and neatly spread into tees and connected to their respective terminals. Sufficient slack shall be allowed in cables for alterations in terminal connections. Lacing shall be done with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for wire runs, lacing is not necessary when the wire is properly installed in the ducts. Slack shall be provided in junction and pull boxes and in handholes and manholes. Amount of slack shall be equal to the largest perimeter dimension of the box.
- F. Wires crossing hinges shall be made up into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.

#### G. Electrical Tape Usage:

1. For insulating connections of #8 AWG wire and smaller: 7 mil vinyl tape.
2. For insulating splices and taps of #6 AWG wire or larger: 10 mil vinyl tape.
3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather vinyl tape.

#### H. Pulling:

1. No oil, grease or similar substances shall be used to facilitate the pulling in of conductors. Use a specifically approved wire pulling compound.
2. No wire or cable shall be pulled in until all construction which might damage insulation or fill conduit with foreign material is completed.
3. Wire shall be pulled into conduits with care to prevent damage to insulation, using basket pulling grips to avoid slipping of insulation on conductors. Nylon rope or other "soft" surfaced cable must be used for pulling in conduits other than steel.

#### I. Connections:

1. Stranded conductors #8 and smaller shall be terminated with terminals of appropriate size where connected to screw type lugs.
2. Joints, splices and taps in dry locations for conductors #8 and smaller shall be made with twist-on connectors suitably sized for the number and gauge of the conductors.
3. Furnish and install proper lugs in all service pedestals, panelboards, motor control centers and gutters as required to properly terminate every cable. Where paralleled conductors, or conductors of large size are to terminate on a breaker, a short length of copper cable (of capacity of the breaker) shall be connected to the breaker, and the proper compression type lug installed to connect this cable to the feeder cable. The cutting of cable strands to fit the breaker will not be permitted.
4. Only crimping tools approved by the manufacturer of the terminals or lugs shall be used.
5. Uninsulated lugs and wire ends shall be insulated with layers of plastic tape equal to insulation of wire and switchboards, with all irregular surfaces properly padded with insulating putty prior to application of tape. Wire in service pedestals, panels, cabinets, pullboxes and wiring gutters shall be neatly grouped together and laced with #12 standard lacing twine, or cable ties.
6. In underground location, joints, splices and taps shall be insulated by the "Skotchcast" epoxy-resin method. In-line splices may be insulated by approved waterproof "shrink tube" method.
7. In service pedestals, panels, pull boxes, gutter, etc. conductor shall be neatly fanned out and tagged with wire markers.
8. At outlets, junction boxes, pull-boxes, fittings, etc., conductors shall be looped or pigtailed to extend at least six inches without splice beyond such wiring enclosures, and where used, pigtails added to loops for connection to fixtures or devices shall be at least six inches long.
9. Conduit shall be capped during construction by means of manufactured conduit seals or caps to prevent entrance of water or debris, and shall remain closed until ready for use.

### 3.03 Installation

- A. Install all wiring in raceway unless otherwise indicated on the drawings.

- B. Power Feeder, power branch, control and instrumentation circuits shall be not combined in conduit, wireway, junction or pull boxes; except as permitted in the following:
  - 1. Where specifically indicated on the drawings or field conditions dictate and written permission is obtained from the Engineer.
    - a. Feeder and branch circuits shall be isolated from each other and from all control and instrumentation circuits.
    - b. Control circuits shall be isolated from feeder, branch and instrumentation circuits.
    - c. 12 VDC, 24 VDC and 48 VDC may utilize a common raceway.
    - d. 125 VDC shall be isolated from all other AC and DC circuits.
    - e. AC control circuits shall be isolated from all DC circuits.
- C. Instrumentation circuits shall be isolated from feeder, branch and control circuits.
- D. Ground the drain wire of shielded cables at one end only.
- E. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
- F. Make splices and taps only at pull or junction boxes.
- G. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.
  - 1. Contractor shall supply terminal boards as required.
  - 2. Do not field wire directly to devices.
  - 3. Ground both ends of spare wires.
- H. All conduits containing conductors shall be sealed as the conduit enters pull boxes and electrical vaults and manholes. Power conductor, control conductors, and instrumentation conductors shall be bundled and supported separately and independently in pullboxes, vaults and manholes.
- I. Cables:
  - 1. Do not splice without permission of the Engineer or the Owner's Representative. Locate splices, when permitted, only in readily accessible cabinets or junction boxes using terminal strips. Splices will not be permitted unless deemed necessary by approved pulling tension calculations.
  - 2. Where connections of cables installed under this section are to be made under Division Instrumentation and Controls, leave pigtails of adequate length for neat bundled type connections.
  - 3. Instrumentation, computer, and control cables run under infinite access floors in control rooms may be installed under the floor without protection. Run individual wires, pairs, or triads in flex conduit under the floor or grouped into bundles at least ½ inch in diameter.
  - 4. Maintaining the integrity of shielding of instrumentation cables is essential to the operation of the control systems. Take special care in cable installation to ensure that grounds do not occur because of damage to the jacket over the shield.
  - 5. Cables entering manholes, handholes or vaults shall be sealed using an expanding foam product approved for the purpose.
- J. Conductor Arc and Fireproofing Tapes
  - 1. Use arc and fireproofing tapes on all 600-volt single conductors and cables except those rated Type TC at splices in all maintenance holes, handholes, vaults, cable trays, and other indicated locations. Wrap together as a single cable all conductors entering from each conduit.

2. Follow tape manufacturer's installation instructions. Secure the arc and fireproofing tape at frequent intervals with bands of the specified glass cloth electrical tape. Make each band of at least two wraps of tape directly over each other.
3. Wrap together as far as possible, conductors carrying phases A, B, and C of the same feeder. Do not wrap together conductors carrying only two of the three phases.
4. The cables shall be trained as closely as possible to their final positions.
5. The cables shall be cleaned of all oil, grease, and cable pulling compounds using suitable solvents and cleaners non-injurious to cable and then wiped completely dry.
6. Any projecting surfaces such as fittings, ground connectors or bonding connections shall be covered with an insulating compound to present a smooth continuous surface for taping.
7. Fireproofing tapes shall be submitted as shop drawings for approval. Tapes shall be 3-inch width half-lapped and extend a minimum of 6-inches into the raceway. Use  $\frac{3}{4}$ " glass tape at three foot intervals to hold tape in place.

#### K. Labeling

1. Each power and control circuit conductor shall be identified as shown at each terminal to which it is connected with a legible permanent coded marking sleeve. This includes all wiring terminations whether field terminations or interior wiring within switchboards, motor control centers, control panels, equipment, and junction panels and boxes.
2. In each manhole, handhole and pull box, each conductor shall be similarly marked with a split sleeve, machine marked so the identification can be made using groups of letters and numbers.
3. Each wire and conductor shall be labeled with a wire label that corresponds and matches the wire labels shown on the approved interconnect drawings, loop drawings or elementary wiring diagrams.
4. For neutral wires such as jumpers between adjacent relay coil neutral terminal that are less than 7 inches in length, the wire label may be omitted if there isn't sufficient space for the labels.
5. Wire numbering shall be compatible and consistent with existing system and shall be approved by the engineer.
6. For general lighting and 120 volt powered receptacles, the wire labels shall be installed at each device with a label that consists of the panelboard name and the circuit number. For example, the Circuit Breaker located in the number 1 position of Panelboard "OPL2 would have its associated wiring labeled as "PNLOPL2-L1 (line power) and "PNLOPL2-N1 (Neutral).

#### L. Wire and Cabling Termination and Splicing

1. Power and control conductors shall be terminated in terminal blocks with solderless box lugs. Signal leads shall be terminated in terminal blocks with saddle-type pressure connectors capable of receiving two No. 16 AWG or smaller conductors on each point.
2. Splices in power wiring shall be made with two compression lugs bolted together. Splices in stranded control wiring or lighting circuits may be made with compression connectors. Splices in signal wiring shall be soldered. Splicing shall not be considered as a normal method of construction. Splicing shall be used only when no practical alternative exists to using terminals or point-to-point wiring. When utilized, splicing of 600 V or less insulated wire shall be made only in junction boxes. No splicing shall be permitted in conduit fittings.
3. Solid wire shall not be lugged nor shall electrical spring connectors be used on any wiring. Lugs and connectors shall be installed with a compression tool recommended by the lug

manufacturer for the particular lug used. Pulling tensions shall not exceed the cable manufacturer's recommendations.

4. All conductors shall be tagged at each end in motor control centers, control panels, service pedestals and control stations with a legible permanent coded wire-marking sleeve. All conductors shall be identified in each manhole, handhole or pull box. Field conductors shall be similarly tagged at each end, except that each conductor termination shall have its marking sleeve imprinted with terminal identification for both ends of the conductor. A schedule shall be provided with the record drawings correlating these wire markings.
5. All splices and terminations for No. 1/0 AWG cable, and larger, shall be inspected by the Engineer prior to and after insulation is applied. Terminations at polyphase motors shall be made by bolt connecting the lugged conductors and then applying rubber filler tape and two 2-lapped layers of vinyl tape to equal or exceed the thickness of conductor insulation.

#### M. Grounding

1. A grounding system shall be installed in accordance with the National Electrical Code and specification section 16450. All grounding surfaces shall be thoroughly cleaned before connecting the grounding electrodes. All conduit shall be grounded directly or through equipment frames and ground buses to the grounding system.
2. In addition to the conduit system, all equipment having 480 volt, 120/208 volt or 120/240 volt supply shall be grounded to the supply source ground bus by a green insulated code sized ground conductor installed in the conduit with the phase cables. Ground conductors for small panels and equipment shall be of same size as associated conductors.

#### 3.04 Adjusting / Cleaning / Protection

- A. 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.
- B. All debris and moisture shall be removed from both new and existing raceways, boxes, and cabinets before installing wire or cable

**\*\*END OF SECTION\*\***

**SECTION 16125  
MANHOLES, HANDHOLES, & PULLBOXES**

**PART 1 - GENERAL**

**1.01 Summary**

- A. Scope: This section provides specifications for all concrete electrical manholes, handholes and pull boxes.
- B. Type: Manholes, handholes and pull boxes shall be cast-in-place or pre-cast concrete sections as shown.
- C. Sizing: Manhole, handholes and pull boxes shall be of a minimum size as shown on the Contract Drawings and in accordance with NEC Article 370 requirements based on size, quantity of conductors and conduit clearances. If no minimum size manhole, handhole and pull box is shown on the contract drawings, the minimum size shall be in and in accordance with NEC Article 370 requirements based on size, quantity of conductors and conduit clearances

**1.02 Submittals**

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

**1.03 Project / Site Conditions**

- A. The manholes, handholes and pull boxes will be installed in water facilities. The manholes, handholes and pull boxes may be subject to corrosive soil and moisture.

**PART 2 - PRODUCTS**

**2.01 Manufacturers**

- A. Manufacturers: Christy Concrete Products; Jensen Precast, Inc.; Brooks Products, Inc.; or equal.

**2.02 Equipment and Materials**

- A. Concrete
  - 1. The structural concrete shall conform to the requirements of Division 3 of these specifications.
  - 2. The aggregate shall be free of deleterious substances causing reaction with hydrogen sulfide.
  - 3. The cement shall be Portland cement conforming to ASTM C150, Type II. Cement content shall be sufficient to produce a minimum strength of 3000 psi.
- B. Reinforcing Steel
  - 1. All reinforcing steel including welded wire mesh shall be as shown. All reinforcing shall be sufficiently tied to withstand any displacement during placement of concrete. All bars shall be hard grade billet steel conforming to ASTM A15. Bars 1/4-inch round and smaller shall be deformed in accordance with ASTM A305.
  - 2. Design loads shall consist of dead load, live load, impact and, in addition, loads due to water table and any other loads which may be imposed on the structure.
  - 3. Live loads shall be for H-20 loading per AASHTO standards for highway and bridges.
- C. Box dimensions shall be the minimum sized as shown on Contract drawings and in accordance with size, quantity of conductors, and conduit clearances per NEC Article 314 requirements.

- D. Manholes: Manholes may be of single- or multiple-section construction. Multiple sections shall be fitted to form watertight joints using tongue and groove joint with flexible plastic adhesive sealing compound.

### **2.03 Components and Accessories**

#### **A. Covers**

1. Manholes, handholes and pull boxes shall be provided with cast iron or galvanized steel covers and mounting rings reinforced for H-20 loading.
2. Pull boxes, 4 feet square and less than 4 feet 6 inches deep shall have a two-piece rectangular cover. Pull boxes, 2 feet by 3 feet in size shall have a one-piece rectangular cover. All other pull boxes, manholes, and handholes shall have a 30-inch diameter ring cover as shown. Covers shall be bolted down with recessed bolt heads.
3. Each manhole, handhole and pull box cover shall be identified by a cast in label. The cover shall be inscribed with the cast letters ELECTRICAL for electrical service or SIGNAL for communication or instrumentation. In addition, the identification number of the manhole or pull box shall be installed by means of bead weld in letters not less than 1 inch high.
4. Where located in streets or other heavy traffic bearing areas, covers shall be of the heavy street traffic type. When located in sidewalks or other non-vehicular traffic areas and with the approval of the construction manager covers may be of the parkway type.
5. Utilize heavy-duty type frames and covers made of cast iron, suitable for H-20 loading, and having machined bearing surfaces. Provide indented type covers, solid top design, with two drop handles each. On the upper side of each cover, cast or burned by welder, in integral letters not less than 2-inches high appropriate titles, ELECTRICAL, SIGNAL or TELEPHONE.

#### **B. Inserts**

1. Concrete inserts for cable racks shall be provided in the walls of each manhole and pull box, one in a 4-foot wall and two in a 6-foot or 8-foot wall.
2. Cable pulling eye bolts shall be provided opposite each conduit entry area, and the inserts shall be designed to provide a minimum of 5,000 pounds tensile strength to accommodate all cable pulls.

### **2.04 Fabrication**

#### **A. Conduit Entrances**

1. Entries of conduits through walls shall be terminated in a bell flush with the interior wall.
2. Conduit wall penetrations shall be repaired with non-shrink grout.
3. Provide raceway entrances on all four sides. For raceways installed under this Contract, knockout panels or precast individual raceway openings may be used. On sides where no raceways are installed under this Contract, provide knockout panels for future raceway installation.
4. Slope floors toward drain points, leaving no pockets or other non-draining areas.
5. Utilize maintenance hole and handhole hardware of steel, hot-dip galvanized after fabrication

### **2.05 Source Quality Control**

- A. All prefabricated maintenance holes shall be shop inspected before delivery to the site.

## **PART 3 - EXECUTION**

### **3.01 Examination**

- A. The location of pull boxes, manholes and vaults are shown on Contract drawings to be at their approximate location. The contractor shall adjust these locations to avoid conflicts with other underground utilities.
- B. Limit the number of directional changes to the conduit to total no more than 270 degrees in any run between pull points. Where required to ease pulling and as necessary to meet the NEC requirements, the Contractor shall supply and install pull boxes, manholes or vaults, even though not shown on the Drawings at no additional cost to the Owner.

### **3.02 Preparation**

- A. The pre-cast base section shall be placed on a prepared base of 12 inches of sand or gravel for even distribution of load before leveling. A plastic preformed joint sealant shall be applied between sections. The joint sealant compound shall be impermeable to water, have a high immediate bonding strength, and maintain permanent plasticity. The assembly shall be so located that surrounding paving shall slope up 1 inch above finish to prevent water settling on the cover. In unpaved areas, the slope shall be up 3 inches.
- B. Conduit runs between two vaults, manholes, or pull boxes shall be limited to a maximum of 300 feet or less 50 feet for every 90 degrees of conduit change in direction

### **3.03 Installation**

- A. The location of manholes, handholes, and pull boxes are shown on the Contract Drawing at their approximate location. The Contractor shall adjust the location of these manholes, handholes, and pull boxes to avoid conflict with other underground utilities at no additional cost to the Owner. Provide excavation, shoring, bracing, backfilling, grading, etc., in accordance with requirements specified elsewhere in these Contract Documents.
- B. Make installation so that raceways enter manholes, handholes or pullboxes at nearly right angles and as near as possible to one end of a wall, unless otherwise indicated.
- C. Pull Boxes, Manholes and Vaults shall be installed accurately to match the surrounding building outline, pavement or sidewalk grade. Set pullboxes parallel or perpendicular to adjacent structures.
- D. Install one ground rod in each manhole and handhole. Connect all noncurrent-carrying metal parts in the manholes and any metallic raceway grounding bushings to this ground rod with No. 6 AWG (minimum) copper conductor.
- E. Vault, Manhole and Pull Box Entry: Conduits entering underground pull boxes and vaults shall be horizontal, except when required otherwise by Power or Telephone Utility Standards. Conduit shall not enter through the bottom of boxes unless boxes are located above grade.
- F. Install covers flush within finished paved or concrete surfaces. In unfinished areas, install covers one inch (1") above finished grade.

### **3.04 Field Quality Control**

- A. Keep boxes, vaults and manholes closed at all times when not being accessed to prevent entry of foreign matter. Cover to protect them against dirt, paint, water, chemical or mechanical damaged products prior to final acceptance.
- B. Clean and remove all debris from maintenance holes and handholes whether new or existing.

- C. At the contractor's discretions and with approval of the Owner's Representative, the Contractor may provide additional manholes, handholes and pull boxes, at no additional cost to the Owner.

**\*\*END OF SECTION\*\***

# SECTION 16130 WIRING DEVICES

## PART 1 - GENERAL

### 1.01 Summary

A. Scope: This section provides specifications for all electrical receptacles, plugs, plug strips, switches, device plates and surface covers.

### 1.02 References

A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
NEC	National Electrical Code, Latest Edition
NEMA WD1	General Wiring Devices
NEMA WD6	Wiring Devices Dimensional Requirements
UL 498	Attachment Plugs and Receptacles
UL 943	Ground-Fault Circuit-Interruption
UL 1449	Safety for Surge Protective Devices
Federal Specification WC596	Connector, Electrical, Power
Federal Specification WC- 896	Switches, Toggle (Toggle and Lock), Flush Mounted
NEMA TC-3-2004	PVC Fittings for Use with Rigid PVC Conduit and Tubing

### 1.03 Submittals

A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

### 1.04 Quality Assurance

- A. All wiring devices shall be premium quality suitable for installation in water facilities and may be subjected to dust and moisture. All wiring devices shall be of the heavy-duty type with ratings as shown on the drawings or as specified.
- B. All wiring devices shall be listed by UL or other testing firms that are recognized by the Owner.
- C. All wiring devices shall comply with Federal Specification WS896 and WC 596 for switches and receptacles respectively.
- D. All wiring devices shall comply with NEMA configurations and standards for general and special purpose wiring devices.

### 1.05 Delivery, Storage, and Handling

A. Refer to Section 16010, 1.07 for requirements.

## **1.06 Project / Site Conditions**

- A. The receptacles; plugs, together with all plug strips; switches and device plates will be installed in water facilities and reservoirs where temperature is expected to range from 10 degrees F and 115 degrees F. Relative humidity is expected to range between 10 and 100 percent.

## **1.07 Warranty**

- A. Refer to Section 17506 for requirements.

## **1.08 Maintenance**

- A. Refer to Section 17506 for requirements.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Make like items of equipment the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts and manufacture's service. Wiring devices shall be of the manufacturer and model numbers described in this specification section.

### **2.02 Equipment and Materials**

- A. General: All wiring devices shall be industrial extra heavy duty specification grade with provisions for back wiring and side wiring with captive-held binding screws. All receptacles shall be of the grounding type.
  - 1. Devices located in areas with suspended ceilings or stud walls shall be ivory finish.
  - 2. Devices located outdoors shall be black.
  - 3. Devices located corrosive environments shall be yellow.
- B. Single Phase Receptacles and Plugs:
  - 1. 120V RECEPTACLES: 120V receptacles shall be NEMA 5-20R and shall accept NEMA 5-15p or 5-20p plug caps. These shall be Cooper 5362 Series, Hubbell 5362 Series, Leviton 5362 Series or equal.
  - 2. 120V GFCI Receptacles: 120V GFCI receptacles shall be UL listed and shall have provisions for trip indication, testing and resetting. : 120V GFCI receptacles shall meet or exceed UL 943 (Class A GFCI), UL 498. These shall be Copper VGF20V Series, Hubbell GFR5362SG Series, Leviton 7899-SG Series or equal.
  - 3. Locking 250 volt, 3 phase receptacles shall be NEMA L15-20 or L15-30 as applicable.
    - a. Receptacles rated for 20 amps shall be Cooper CRL152OR Series, Hubbell HBL2425SW Series or equal.
    - b. Receptacles rated for 30 amps shall be Cooper CWL153OR Series, Hubbell HBL2725SW Series or equal.
  - 4. Corrosion-Resistant Receptacles: Receptacles called out "corrosion-resistant" shall be of yellow nylon construction with all metal parts of monel or cupro-nickel complying with Federal Specification W-C-596d. Corrosion resistant receptacles shall be Cooper 5362GR Series, Hubbell HBL53CM62 Series, or equal.
  - 5. Weatherproof UL listed While-In-Use Covers: Weatherproof While-In-Use Covers will be provide with corrosion-resistance receptacles shall be designed so that the watertight integrity

of the plug-receptacle is maintained when the units are plugged together and the live parts are equally protected when the plug is removed and when the cover is in place. The units shall consist of oil-resistant metal cover assemblies with a corrosion-resistant polycarbonate receptacle bodies. Plug caps shall match the receptacle and shall be of the same manufacturer. Metal Cover closed cell neoprene form gasket. These shall be Cooper WIUMV-1, Hubbell WP8MH or equal.

6. Plug Caps: Except for Corrosive Environments, Plug caps shall be industrial grade, of the cord grip type with black and white nylon housing, Hubbell HBL5266C, Leviton 5266C or equal. For Corrosion Environments, plug caps shall be corrosion resistant yellow nylon housing, Hubbell HBL52CM66C, Leviton 52CM-66C or equal and shall be of the same configuration and manufacture as the receptacle. One plug shall be supplied for each four receptacles, installed of a given configuration, figured to the next larger standard carton. Plugs shall be delivered in original sealed cartons to the Resident Engineer.
7. Plug Strips: Plug strips shall be of steel sheet metal or special stainless steel where called for. The dimensions of the plug strips shall be such that standard duplex receptacles and devices can be mounted in the cover section of the plug strip, with sufficient space behind the device for ten No. 12 AWG circuit conductors in accordance with NEC space rules. Plug strips shall be Wiremold No. G3000, SnapMark SMS3200, or equal.
8. Special Purpose NEMA Configuration Receptacles: Special purpose NEMA configuration receptacles shall be industrial grade, corrosion resistant and shall be as follows:

- a. Provide Manufacturer and Model Number, noted below, or approved equal.
- b. Non-locking 125/250 volt, 20 to 60 ampere ratings shall be NEMA 14-20 through 14-60 series:

Ampere Rating	NEMA Rating	Cooper	Hubbell
20	14-20R	5479	HBL8410
30	14-30R	n/a	n/a
50	14-50R	5759	HBL9450A
60	14-60R	AH5754AP	HBL9460A

- c. Non-locking 250 volt, 3 phase, 15 to 60 ampere ratings shall be NEMA 15-15 through 15-60 series:

Ampere Rating	NEMA Rating	Cooper	Hubbell
15	15-15R	n/a	n/a
20	15-20R	n/a	HBL8420
30	15-30R	8430N	HBL8430A
50	15-50R	8450N	HBL8450A
60	15-60R	8460N	HBL8460A

- d. Locking 120/208 volt, 3 phase, 20 or 30 ampere ratings shall be NEMA L21-20 and L21-30:

Ampere Rating	NEMA Rating	Cooper	Hubbell
20	L21-20R	CWL2120R	HBL2510SW
30	L21-30R	CWL2130R	HBL2610SW

- e. Locking 250 volt, 3 phase receptacles shall be NEMA L15-20 or L15-30 as applicable:

Ampere Rating	NEMA Rating	Cooper	Hubbell
20	L15-20R	CWL1520R	HBL2420SW
30	L15-30R	CWL1530R	HBL2720SW

9. Water Proof Three-Phase Receptacles and Plugs: Three phase receptacles shall be for 3 phase, 4 wire, 480 volt service, with ampere rating as shown, of the type manufactured from high impact thermoplastic housing with an Arc resistant UL94-VO phenolic thermoset inserts. The receptacles and plugs shall be of the grounding type and shall be so designed that the grounding pole is permanently connected to the housing. The grounding prong or pole shall make contact before the line poles are engaged when the plug is connected to the receptacle housing. The plug sleeve shall also make contact with the receptacle housing before the line and load poles make contact. The receptacles and plugs shall be UL listed and CSA certified for circuit interrupting at full rated current. Shrouded contacts shall comply with California Code Title 8, Article 51, S2510.7 (b) for devices exceeding 300 VAC with horsepower ratings per NEC 420-151. The receptacles and plugs shall be moisture resistant per UL 1682 Paragraph 40. Receptacles shall have watertight/flap screw covers, O-rings on all pins and sleeves, interiors and plug shell. The receptacles and plugs shall be watertight even when not engaged. The receptacles and plugs shall meet requirements for NEMA 4, 4x, 6 and IP67. Receptacles and Plugs shall be Russellstoll DuraGard Series, Hubbell Insulgrip or equal.

#### C. Switches

1. General Purpose: General-purpose switches shall be quiet AC type, industrial specification grade, UL listed for motor loads up to 80 percent of rated amperage, and shall be installed in accordance with the required rated capacities. Switches shall match receptacles in color. Switches shall be rated 20 Amps, 120 – 277 volts, and shall be as follows:
  - a. Single Pole On-Off Operation: Cooper 2221V, Hubbell HBL1221I or equal.
  - b. Double Pole On-off Operation: Cooper 2222V, Hubbell HBL1222I or equal.
  - c. Three-Way On-Off Operation: Cooper 2223V, Hubbell HBL1223I or equal.
  - d. Four Way On-Off Operation: Cooper 2224V, Hubbell HBL1224I or equal.
2. Weather-Exposed and Corrosive: Maintained contact switches in weather- exposed and corrosive areas or where shown on the drawings shall be the tap action type with weather proof yellow switch plate. Switches shall be rated 20 Amps, 120 – 277 volts, and shall be as follows:
  - a. Single Pole On-Off Operation: Cooper 2991V with AH2881, Hubbell HBL1281I with HBL17CM50 or equal.
  - b. Double Pole On-off Operation: Cooper 2992V with AH2881, Hubbell HBL 1281I with HBL17CM50 or equal.
  - c. Three-Way On-Off Operation: Cooper 2993V with AH2881, Hubbell HBL 1281I with HBL17CM50 or equal.
  - d. Four Way On-Off Operation: Cooper 2994V with AH2881, Hubbell HBL 1281I with HBL17CM50 or equal.
3. Tap-Action switches in weather-exposed and corrosive areas shall be mounted in "FS" type mounting boxes with weatherproof Hypalon or neoprene cover plates.

- D. Timer Switches: Timer switches shall have a black knob and a brushed aluminum plate with a spiral time scale to provide easy selection of time setting desired. The knob shall be a press on

type requiring no screws or other hardware to secure. The timer shall have a UL listed rating of 1 HP 125 VAC, 50/60 Hz. The timer shall be SPDT. The timer shall not have a hold feature and shall have a time cycle of 15 minutes. The timer shall be Intermatic Model FF15MC, Paragon SWP15M, or equal.

## 2.03 Components and Accessories

### A. Communication Wiring Interface

1. The communication wiring interface shall consist of a six-port wall plate and device box for user connection with telephone and computer networks at the various locations shown on the drawings. The communication wiring interface shall be the Leviton Quickport MOS 3, Hubbell iStation or approved equal to the criteria that follows:
  - a. All communication modules shall fully comply with NEC Article 800, be UL listed and meet FCC Part 68 requirements.
  - b. Modules shall be of a high-impact, self-extinguishing plastic that is UL 94V-0 rated.
  - c. Contacts shall be spring wire with phosphor bronze plated with 50 micro-inches of hard gold over 100 micro-inches of nickel. Jacks shall be Cat 5, Cat 5e, Cat 5e + or Cat 6 as required by the drawings.
  - d. Wall plates and jacks shall be provided as follows:
  - e. Six-port wall plates shall be flush mounted and field convertible. Wall plates shall house any combination of six (6) eight-conductor keyed jacks. Jacks shall be interchangeable depending on the application.
  - f. Two-port wall plates shall have up to two eight conductor keyed jacks using insulation displacement connectors with punch-down caps for installation.
  - g. The color key for the jacks shall be as follows:
    - 1) Telephone network: Ivory
    - 2) Data Network – Cat 5: Blue
    - 3) Data Network – Cat 5e: Red
    - 4) Data Network – Cat 6: Yellow
    - 5) Spare: Black
2. Wall plates shall be mounted in a 2" x 4" (minimum device box).

### B. Device Plates

1. General
  - a. Stainless steel device plates shall be engraved directly with the service legend. Engraving shall be 1/8 inch high with black filling. Cast ferrous metal plates shall be provided with engraved laminated phenolic nameplates with 1/8-inch white characters on black background. Nameplates for switches shall identify the panel and the circuit number and the area served. Nameplates for receptacles shall identify circuit and voltage, if other than 120 volts single phase. Engraving schedule shall be submitted for review prior to engraving.
  - b. Device plates located in areas with suspended ceilings and stud walls shall be Type 302 stainless steel, satin finish, and 0.40-inch minimum thickness. Device plates in all other areas shall be cast ferrous metal with neoprene gasket and corrosion-resistant hardware. Receptacle covers exposed to weather shall be provided with while-in-use covers.

- c. Device covers for corrosion-resistant applications shall be yellow thermoplastic or aluminum construction with a spring-closed cover for the outlet. The receptacle cover shall be Hubbell 52CM22, or Cooper 7879FSCR or equal.
2. Switch Covers: Switch covers shall be heavy cast aluminum with bat-handle toggle operators and shall be Appleton, Killark or Crouse-Hinds. Stainless steel screws and neoprene gasket shall be provided with each cover. Where scheduled, nameplates shall be phenolic in accordance with the specifications for nameplates, except the lettering shall be 1/8 inch high.
3. Receptacle Covers: Receptacle covers shall be heavy cast copper-free aluminum with a gasketed spring floor cover over each outlet. The receptacle cover shall have all exposed metal surfaces factory coated with a durable epoxy coating. Stainless steel screws and a neoprene gasket shall be provided with each receptacle cover

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. Galvanized brackets, expansion bolts, toggle bolts or machine or wood screws according to the type of construction shall secure boxes. Wooden plugs inserted in masonry or concrete shall not be used as a base to secure boxes.
- B. Finish Plates and Devices: Do not install items until finish painting is complete. Scratched or splattered finish plate and devices shall be replaced at the Contractor's expense.
- C. GFCI Outlets: One GFCI receptacle may be used to provide GFCI protection to downstream duplex receptacles on the same branch circuit provided the following conditions are met.
  1. The downstream receptacles are in the same room as the upstream GFCI duplex receptacles, and.
  2. The downstream duplex receptacles are labeled as being protected by an upstream GFCI receptacle in the same room.

### **3.02 Installation**

- A. Unless otherwise shown, receptacle boxes shall be mounted 12 inches above the floor in offices, control rooms, and similar areas; shall be mounted 6" above back splash of countertops, and shall be mounted 48 inches above the floors in other locations unless otherwise shown.
- B. Upon installation of wall plates and receptacles, Contractor shall use care regarding their proper and cautious use. At time of substantial completion, replace those items which have been damaged, including those burned or scored by faulty receptacles or cord caps.
- C. Plumb: Install devices and finish plates plumb with building lines and equipment cabinets.
- D. Wall-Mounted Receptacles: Install with long dimension oriented vertically at centerline height shown on the drawings or specified herein.
- E. Vertical Alignment: When more than one outlet is shown on the drawings in close proximity to each other, but at different elevations, align the outlets on a common vertical center line for best appearance. Verify alignment with Construction Manager

### **3.03 Field Quality Control**

- A. Test wiring devices to ensure electrical continuity of grounding connections, and after energizing circuitry, to demonstrate compliance with requirements.
- B. Test receptacles for line to neutral, line to ground and neutral to ground faults.

- C. Test ground-fault circuit interrupter operation according to manufacturer recommendation.
- D. Correct any defective wiring.
- E. Replace damaged or defective components.

### **3.04 Adjusting / Cleaning / Protection**

- A. General: Internally clean devices, device outlet boxes and enclosures. Replace stained or improperly painted wall plates or devices.

**\*\*END OF SECTION\*\***

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# SECTION 16140 DISCONNECTS AND FUSED SWITCHES

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This section specifies all disconnects, fused and unfused, required by code for equipment furnished under this and other Divisions of these specifications.
- B. All materials and equipment specified herein shall be within the scope of a Nationally Recognized Testing Laboratory (NRTL) examination services, be approved by the NRTL for the purpose for which they are used, and shall bear the appropriate listing label.
- C. When a project is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority undergo a special inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price.

### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
FS-W-C-375	Federal Standard – Circuit Breakers, Molded Case, Branch Circuit and Service
NEMA AB-1	Molded Case Circuit Breakers and Molded Case Switches
NEMA KS-1	Enclosed Switches
NFPA 70	National Electric Code
UL 98-94	UL Standard for Safety Enclosed and Dead-Front Switches
UL 512-93	UL Standard for Safety Fuseholders
OSHA	Occupational Safety and Health Act

### 1.03 Submittals

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010. Show material information and confirm compliance with these specifications.

### 1.04 Delivery, Storage, and Handling

- A. Refer to Section 16010, 1.07 for requirements

### 1.05 Project / Site Conditions

- A. All disconnects and fused switches will be installed in a water facility where the ambient temperatures may range between 10 degrees F and 115 degrees F. Relative humidity is expected to range between 10 and 100 percent. In some areas, the equipment may be subjected to dust, moisture, and corrosive atmospheres

## **1.06 Sequencing and Scheduling**

## **1.07 Warranty**

A. Refer to Section 17506 for requirements.

## **1.08 Maintenance**

A. Refer to Section 17506 for requirements.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

A. Disconnect switches shall be manufactured by Eaton Cutler Hammer, Square D, General Electric or equal.

### **2.02 Equipment and Materials**

A. Disconnects

1. Disconnect switches shall be heavy duty type, shall be horsepower rated, quick-make, quick-break construction. Switch blades shall open all ungrounded conductors and shall be single throw, unless otherwise noted.
2. Rating: 600 volts AC or DC, number of poles and amp rating as shown on the Drawings.
3. Disconnect switch enclosures shall be suitable for location in which mounted in accordance with Section 16010, 1.08.
4. Fusible disconnects shall be as specified above with fuse space and clips to accept Class R fuses. Fusible disconnects shall only be utilized where required by equipment manufacturer to meet UL installation requirements.

## **PART 3 - EXECUTION**

### **3.01 Installation**

A. Switches shall be mounted at locations shown on plans. Installation shall be in accordance with the following methods:

1. Mounting: Disconnects shall be fastened securely to supporting structure at wall and stands:
  - a. Machine bolt to metal framing or metal plates
  - b. Expansion anchors to concrete wall where approved by the Engineer
    - 1) Provide one inch spacers to set enclosure out from concrete wall
  - c. Expansion toggle wing bolts or sleeve anchors to hollow block where approved by the Engineer.
    - 1) Provide one inch spacers to set enclosure out from hollow block wall
  - d. Provide equipment mounting rack per NEC or as indicated on the drawings.
  - e. Wood screws or lag screws to wood boards or timbers where approved by the Engineer.
2. Stands and Supports: Disconnect stands and support shall be constructed of and secured by:
  - a. Corrosion-resistant materials and finishes

- b. Unistrut-type materials for fabrication
  - c. Machine bolt to metal framing or metal plates
  - d. Metal backing plate for mounting units
  - e. Wood screws or lag screws to wood boards or timber where approved by the Engineer
  - f. Fasten stand securely to floor
  - g. Dimensions as required by equipment to be mounted
3. Arrangement: Disconnects shall be arranged for driven equipment use or function:
- a. Similar units adjacent
  - b. Adequate space for operation and servicing
4. Mounting Height: Disconnect mounting height:
- a. Center of handle shall be 4 feet 6 inches above the finished floor or work platform.
5. Nameplates shall be provided for all disconnects in accordance with Section 16160, 2.03, C. Nameplate to state load designation and power source equipment.

**\*\*END OF SECTION\*\***

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# SECTION 16155 MOTOR STARTERS

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This Section provides specifications for all motor starters and associated equipment, except for variable frequency drives:
1. The Contractor shall furnish and install all group-mounted and unit motor control as required for each motor furnished for installation all in accordance with the requirements of the Contract Documents.
  2. When motors furnished differ from the indicated, the Contractor shall, at no additional cost to the Owner, make the necessary adjustments to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate the motors actually installed.
- B. Type: As shown on the Contract Drawings, motor starters shall be the full voltage combination magnetic type, reduced voltage solid state starter type, or manual type with fully magnetic circuit breakers and thermal overload elements.

### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
CCR, Title 8, Subch.5	California Code of Regulations, Title 8, Industrial Relations, Subchapter 5, Electrical Safety Orders
UL 508	Standard for Safety Industrial Control Equipment
UL 845	Standard for Safety Electric Motor Control Centers
NEMA ICS-1	General Standard for Industrial Control and Systems
NEMA ICS-2	Industrial Control Devices, Controllers and Assemblies

### 1.03 Submittals

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.
- B. Final submittal shall include spare parts lists, catalog data for various motor control elements in addition to the submittals requirement by Section 01300 and 16010.
- C. The following submittals and specific information shall be provided:
1. One-line diagrams
  2. Elementary wiring diagrams
  3. Connection wiring diagrams
  4. Interconnection wiring diagrams
  5. Written Operational Description
  6. Installation instructions

7. Maintenance instructions
8. Spare parts list.
9. Test reports including procedures, test conditions, results and graphs.

#### **1.04 Quality Assurance**

##### **A. Performance and Design Requirements**

1. Motor starters furnished shall be of the type indicated on the drawings and shall be suitable for 480-volt, 3-phase, 60-hertz, AC service with 120 volt controls. Motor starters and their components shall be sized in accordance with NEMA standards. Starters smaller than NEMA Size 1 will not be permitted.
2. Unless installed within a service pedestal, motor starters shall be installed in NEMA 1 gasketed or NEMA 12 enclosures or in motor control centers for all indoor locations, in NEMA 7 enclosures in classified areas and in NEMA 4X enclosures for all non-rated outdoor or corrosive locations.

- B. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Engineer of any discrepancies.
- C. Verify the required instrumentation and control wiring for a complete system and notify Engineer of any discrepancies.
- D. Electrical and Mechanical Testing: All components shall be factory tested in accordance with the applicable NEMA ICS requirements.
- E. Field Testing: Field tests shall be performed in accordance with Section 16030 – Electrical Tests.

#### **1.05 Delivery, Storage, and Handling**

- A. Refer to Section 16010 – General Electrical Provisions, 1.07 for requirements.

#### **1.06 Project / Site Conditions**

- A. All motor starters and associated equipment will be installed in a water facility where the ambient temperatures may range between 10 degrees F and 115 degrees F. Relative humidity is expected to range between 10 and 100 percent. In some areas, the equipment may be subjected to dust, moisture, and corrosive atmospheres.

#### **1.07 Sequencing and Scheduling**

- A. Sequencing and scheduling plan shall be provided that minimizes pump station downtime. Note that the pump station must remain operational during all phases of construction. For additional requirements refer to the Special Provisions

#### **1.08 Warranty**

- A. Refer to Section 17506 – Extended Warranty and Maintenance, for requirements.

#### **1.09 Maintenance**

- A. Refer to Section 17506 – Extended Warranty and Maintenance, for requirements.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Make like items of equipment the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service. Motor starters shall be Allen Bradley Power Flex or equal.

### **2.02 Equipment and Materials**

A. General:

1. Provide each motor with a suitable controller and devices that will function as specified for the respective motors and meeting NEMA ICS 2, the NEC, and UL. Each motor control shall consist of a manually operated circuit protective device and controller mounted in a common enclosure, complete with control power transformer, if required and auxiliary devices for control of the circuit as indicated.
2. Operating handle of the circuit protective device shall physically indicate "on", "off", and "tripped" positions. Handle shall accept three padlocks with heavy duty, industrial type shackles. Cover shall be interlocked with the operating handle to prevent opening with in the "on" position. A method shall be provided for releasing the interlock for inspection purposes when the switch is "on".
3. Provide each motor controller with thermal overload protection in all ungrounded phases. Use protection consisting of thermal overload relays meeting NEMA ICS 2 which are sensitive to motor current and mounted within the motor controller, or a combination of thermal protectors embedded within the motor windings and controller-mounted overload relays, as indicated. Use overload protection devices of the inverse-time current characteristic type,
4. Provide controller-mounted overload relays of the manual-reset type with externally operated reset button when used without motor thermal protectors; when used in conjunction with thermal protectors, provide the automatic reset type. Select and install overload relay heaters after the actual nameplate full-load current rating of the motor has been determined.
5. If power factor correction capacitors are connected on the load side of the overload relays, incorporate the resulting reduction in line current in the selection of overload relay heaters.
6. Install and connect any required thermal protector monitoring relay provided by motor manufacturer in motor-control circuit and provide manual reset function.
7. Enclosures shall be as follows:
  - a. Dry Locations: NEMA Type 12
    - 1) Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
    - 2) No knockouts, external mounting flanges, hinged and gasketed door.
  - b. Corrosive Locations: NEMA Type 4X
    - 1) Body and cover: Type 304 or 316 stainless steel.
    - 2) No knockouts, external mounting flanges, hinged and gasketed door.
  - c. Wet Locations: NEMA Type 4X
    - 1) Body and cover: Type 304 or 316 stainless steel
    - 2) No knockouts, external mounting flanges, hinged and gasketed door
  - d. Where mounted in a MCC: meet the requirements of Section 16250.

## B. Manually Operated Starters, Fractional Horsepower

1. Provide starters meeting NEMA ICS 2 with the enclosures shown, rated 1 HP at single-phase, AC voltages of 115 and 230 volts, and with thermal overload protection, and toggle or pushbutton operation. Provide for locking in the OFF position.
2. Provide Allen Bradley Bulletin 600, Cutler Hammer Series E34, or equal.

## C. Manually Operated Starters, Integral Horsepower

1. Provide starters meeting NEMA ICS 2 of the horsepower rating, voltage, number of phases, and enclosure shown and with thermal overload protection, and pushbutton or toggle switch operation. Provide for locking in the OFF position. Provide running overcurrent protection.
2. Provide Allen Bradley Bulletin 609, Crouse-Hinds NMM, Eaton Cutler Hammer or equal.

## D. Full Voltage Magnetic Starters, Enclosed

1. Provide starters meeting NEMA ICS 2, Class A, with the rating and enclosure shown. Starters shall be full voltage, non-reversing horsepower rated, providing combined protection against running and stalled overloads. Thermal overload relays on all phases shall be temperature compensated bimetallic type with manual reset and inherent single phasing prevention.
2. Starters shall be NEMA rated and no smaller than Size 1.
3. Provide Eaton Cutler Hammer ECN 54 series, Allen-Bradley Bulletin 513 series, or equal.

## E. Full Voltage Magnetic Starter, Motor Control Center

1. Provide starters meeting NEMA ICS 2, Class A, with the rating and features shown. Starters shall be full voltage, non-reversing horsepower rated, providing combined protection against running and stalled overloads. Thermal overload relays on all phases shall be temperature compensated bimetallic type with manual reset and inherent single phasing prevention.
2. Starters shall be NEMA rated and no smaller than Size 1.
3. Starters shall all be in draw-out type compartments.
4. Provide Eaton Cutler Hammer Freedom Series, Allen-Bradley Bulletin 500 or equal.

## 2.03 Components and Accessories

A. Magnetic Contactors: Magnetic contactors shall be capable of closing and holding when a minimum voltage of 85 percent is applied to the operating coil. All contactors and relays shall be equipped with at least two normally open and two normally closed auxiliary contacts.

### B. Overload Elements:

1. Unless noted elsewhere in the specification, overload elements shall be bimetallic ambient temperature compensated overload relays. Magnetic contactors for all 3-phase motor starters shall be equipped with overload relays on each phase.
2. Single phase motor starters shall contain one overload trip element for 120 volt applications and two overload trip elements for 208 volt, 240 volt, or 480 volt applications.

### C. Circuit Breakers:

1. Motor circuit protectors shall be rated 65000 AIC symmetrical at 480V. The motor circuit protectors shall provide adjustable magnetic protection and be provided with pin insert to stop magnetic adjustment at 1300% motor nameplate full load current to comply with NEC requirements. All HMCP combination starter units shall have a "tripped" position on the unit disconnect and a push-to- test button on the HMCP. The motor circuit protectors shall include transient override feature for motor inrush current.

2. Molded case circuit breakers on combination type starters shall be fully magnetic with instantaneous trip adjustments. The breakers shall have continuous ratings to match the motor nameplate horsepower shown on the single line diagrams. The circuit breakers shall have a minimum of six trip adjustment points. Circuit breakers shall also have provisions for manual tripping. This trip device shall provide mechanical simulation of overcurrent tripping through activation of linkages and latch surfaces that are not operated by the circuit breaker handle.
3. Magnetic circuit breakers shall have a current limiting fuse where indicated or when the short circuit rating is higher than the basic interruption rating.
4. Combination units without current limiting fuses shall be rated for 65,000 amperes rms; units with current limiting fuses shall be rated for 200,000 symmetrical rms amperes.
5. The circuit breaker shall be designed so the loss of any one or more fuses shall trip the breaker automatically. The external operating handle of the circuit breaker shall have provisions for installing a padlock in the open position. The circuit breakers shall comply with the requirements of sections of these specifications that specify overcurrent protective devices.

D. Control Power Transformers.

1. Supply individual control power transformers unless noted otherwise. The transformers shall be sized to a minimum of 100 percent in excess of the volt-ampere requirements of the holding coil and indicating lights. Fuse one side of the secondary winding and ground the other side. Provide primary, current limiting fuses where fuses shown on Drawings, or where required by applicable codes and standards.

E. Control Devices:

1. Provide control devices as indicated on the contract drawings and as described below
2. Operating and Indicating Devices shall have a minimum rating of NEMA 13
3. Operating and Indicated Devices mounted in outdoor panels, corrosive areas or where exposed to moisture shall be NEMA 4X
4. Selector Switches:
  - a. Selector Switches shall be for use on 120 volt control circuits
  - b. Contacts shall have a continuous rating of 10 amperes both inductive and resistive
  - c. Allen Bradley Bulletin 800H, Eaton Cutler Hammer or equal
5. Pushbuttons:
  - a. Pushbuttons and illuminated pushbuttons shall be for use on 120 volt control circuits
  - b. Shall have a continuous current rating of 10 amperes both inductive and resistive
  - c. Allen Bradley Bulletin 800H, Eaton Cutler Hammer or equal
6. Indicating Lights:
  - a. Indicating lights shall be push-to-test oil tight type
  - b. Units shall include a LED type lamp and shall be of the illuminated pushbutton type with the pushbutton wired for the push-to-test function. Refer to contract drawings for appropriate lens cap color
  - c. Lamps shall be provide for each unit installed
  - d. Allen Bradley Bulletin 800H, Eaton Cutler Hammer or equal

F. Interlock and auxiliary contacts, wired to terminal blocks:

1. Holding circuit contact, normally open
2. Overload alarm contact, normally open
3. Normally open auxiliary contact, for remote run status
4. Additional field replaceable auxiliary contacts where shown on the contract drawings
5. Additional field replaceable auxiliary contacts as required to meet the Control Strategies
6. Two (2) additional normally open spare field replaceable auxiliary contacts

G. Terminal Blocks

1. Terminal blocks for power leads shall be of ample rated capacity for the leads and shall have channel mounted solderless box lugs with pressure plates.
2. Terminal blocks for control wiring shall be of ample size to accept two 12 AWG filed conductors per point. The control terminal blocks shall be channel mounted type of nylon and shall have a binding head or washer-head screw.
  - a. A minimum of 20 percent spare termination points shall be provided for each starter
  - b. Control Terminal blocks shall be rated at 20 amperes minimum at 600 volts, 90 degrees Celsius
  - c. Terminal marking shall be provided for purposes of indentifying terminations

H. Nameplates:

1. Each starter shall have a nameplate designating the function of the device and its identifying number as defined on the P& IDs drawings of the contract drawings.
2. Nameplates shall be submitted for approval by the Engineer as part of the submittal review process.
3. Nameplates shall be engraved type made of 1/8 thick laminated black and white bake-like material with letters not less than 3/16 engraved through the white top lamination to the black interior.

## **PART 3 - EXECUTION**

### **3.01 Examination**

- A. All multiphase motors shall be furnished with magnetic contactor or solid state starters unless otherwise noted on the drawings. Single phase motor starters shall either be magnetic or manual, as indicated on the drawings.
- B. Motor starters for non-reversing, single speed motors rated up to 45 HP shall be full voltage, non-reversing starters unless noted on plans.
- C. Motor starters for single speed non-reversing motors rated above 45 HP shall be solid-state reduced voltage.
- D. The combination starters shall be interchangeable with starters of the same size.
- E. Motor starters shall have replaceable, heavy-duty tungsten tipped contacts of the non-welding type with wipe action to keep contacts clean.
- F. Motor starter wiring and components shall be readily accessible.

### **3.02 Preparation**

- A. Any special protection relays for pumps, mechanical equipment or motors that are required by any pump or motor manufacturer shall be incorporated into the motor starter control circuit at no extra cost.

### **3.03 Installation**

- A. Motor starters installed in service pedestals shall be located as shown in service pedestal furnished by the service pedestal manufacturer.
- B. For motor control centers the starter units and the associated "stab-on" connectors shall include provisions for guiding the units from their disconnected or withdrawn position to their connected position.
- C. Retighten to NEMA standards all current-carrying bolted connections and all support framing and panels.

### **3.04 Field Quality Control**

- A. Perform work in a workmanlike manner with craftsman skilled in the particular trade. Provide work presenting a neat and finished appearance.
- B. Provide a qualified, factory-trained representative to supervise installation, final adjustment, and initial energization of this equipment. Make this representative available for as long as his services are required, but in any case for a period of 2 days minimum. At the end of installation and adjustment, provide certification signed by this representative that the equipment has been properly installed and tested, and is ready for energization.
- C. Testing: Each installed motor starter shall be individually tested to ensure that the starter has been properly installed and connected and that it operates as required and specified.
- D. Grounding circuits shall be tested for circuit continuity and that the circuit resistance is not excessive. Readings in excess of 5 ohms will not be acceptable.
- E. Test all ungrounded circuits to verify that short circuits or accidental grounds do not exist. Reading of at least 100 megaohms to ground shall be obtained on all phase conductors.
- F. Phase rotation tests shall be performed on all three phase circuits with a phase rotation-indicating meter.
- G. Test data shall be recorded and submitted to the Engineer for approval.

### **3.05 Material and Equipment Schedules**

- A. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in the equipment or its location prior to roughing in without incurring any additional cost,
- B. Field adjust the trip settings of all motor starter magnetic trip only circuit breakers. Adjust as per manufacturer's recommendations. Determine motor rated current from motor nameplate following installation. In the selection of overload relay heaters, allow for motor current reduction where power factor correction capacitors are installed on the load side of the overload heaters. Prepare a typed tabulation of motor name, motor horsepower, nameplate full load current, measured load current, heater catalog number, protective device, trip setting, and include copy in the Technical Manual. Attach to the tabulation a copy of the starter manufacturer's overload heater selection tables, including only the tables for the particular starters provided.
- C. After the equipment is installed, touch up any scratches, marks, etc., incurred during shipment or installation of equipment. If required by the ENGINEER because of undue amount of scratches, repaint the entire assembly.

- D. Repair all scratched or damaged surfaces to “like new” condition.
- E. All panels, condulets, pull boxes and junction boxes shall have covers securely in place.

**\*\*END OF SECTION\*\***

# SECTION 16160 PILOT DEVICES

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This section provides specifications for all control stations, pushbuttons, selector switches, elapsed time meters, indicating lamps, control transformers, control fuses, control relays, and related control device appurtenances.
- B. Type: All pilot devices shall be heavy-duty type as shown or as otherwise specified.

### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
ANSI C80.1	Electrical Rigid Steel Conduit
UL 1	Flexible Metal Conduit
UL 5	Surface Metal Raceway and Fittings
UL 6	Electrical Rigid Metal Conduit – Steel
UL 514B	Conduit, Tubing and Cable Fittings
UL 651	Schedule 40 and 80 Rigid PVC Conduit and Fittings
NEMA RNI-2005	PVC Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC-2-2003	Electrical PVC Tubing and Conduit
NEMA TC-3-2004	PVC Fittings for Use with Rigid PVC Conduit and Tubing

### 1.03 Submittals

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

### 1.04 Quality Assurance

- A. The pilot devices shall be heavy-duty type suitable for installation in water facilities.

### 1.05 Delivery, Storage, and Handling

- A. Refer to Section 16010, 1.06 for requirements.

### 1.06 Project / Site Conditions

- A. The pilot devices will be installed in water facilities where the ambient temperatures are expected to range between 10 degrees F and 115 degrees F. Relative humidity is expected to range from 10 percent to 100 percent. The pilot devices may be subjected to dust and moisture.

## **1.07 Sequencing and Scheduling**

- A. Sequencing and scheduling plan shall be provided that minimizes pump station downtime. Note that the pump station must remain operational during all phases of construction. For additional requirements refer to Special Provisions.

## **1.08 Warranty**

- A. Refer to Section 17506 for requirements.

## **1.09 Maintenance**

- A. Standby Components
  - 1. The following standby components shall be provided:
    - a. Twelve (12) - Indicating lamps of each type
    - b. Six (6) - Control fuses of each type
    - c. Two (2) - Control relay and time delay relay of each type
    - d. Four (4) - Indicating lamps lenses of each color
    - e. One (1) - Spare starter operating coil of each type
    - f. Four (4) - Control devices contact blocks

## **PART 2 - PRODUCTS**

### **2.01 Equipment and Materials**

- A. Control Stations: For non-classified areas, control stations shall be heavy-duty industrial units, NEMA 12 oil-tight and dust-tight cast aluminum enclosures unless otherwise specified or shown. Control stations exposed to weather or located in corrosive environments shall be NEMA 4X of fiberglass reinforced high impact plastic, Allen Bradley 800 H series, Crouse-Hinds NCS series, or equal.
  - 1. Legend Plates - ("STOP", "AUTO", etc.) shall be as shown on the plans and nameplates shall be as shown on the plans.
  - 2. Nameplates – Nameplates shall be as shown on the plans.
- B. Pushbuttons: Pushbuttons shall be heavy-duty oil-tight type; lockout-stop buttons shall be equipped with integral locking device and shall additionally be capable of receiving one 3/8-inch shackle padlock. Contact shall be rated as specified for selector switches. Unless otherwise shown, pushbuttons for field stations shall be provided with a watertight boot if the pushbutton is mounted on the outer surface of the enclosure.
- C. Selector Switches: Selector switches located in motor control centers; field stations (generally for HAND-OFF-AUTO operations) shall be heavy-duty oil-tight type.
  - 1. Switches shall be provided complete with cover, front escutcheon, handle and with the legend plate engraved by the switch manufacturer in accordance with the drawings. The manufacturer's standard contact development diagram shall be submitted for each different switch arrangement required. The development diagram shall identify each switch it describes and shall call out all special operating features in addition to providing the standard contact status for each switch position.
  - 2. Where no callout is given, the Contractor shall use the diagrammatic symbol to determine the type of selector to apply in conformance with the electrical symbols drawings.

- D. Elapsed Time Meters: Elapsed time meters shall be of the 2-1/2-inch square case type for flush panel mounting. The totalizing type meter shall have 6-digit register with the last digit indicating tenths of an hour.
- E. Indicating Lamps: Indicating lamps shall be oil-tight units. Units for alternating or direct current systems shall include LED type lamp and shall be of the illuminated pushbutton type with the pushbutton wired for the push-to-test function required.

## **2.02 Components and Accessories**

- A. Control Transformers: Control transformers shall be of the volt-ampere rating required to supply the coil and device loads in the control circuit, but not less than the size if shown, without exceeding their rating or overheating.
  - 1. Control transformers will be required on each starter unless otherwise indicated and shall be connected to terminals on the load side of the branch circuit breaker. Control transformers shall be rated for 480 to 120 volts.
- B. Control Circuit Protection: Draw-out indicating fuse holders and fuses shall be provided as shown for the protection of all control circuits. Fuse holders for service at 150 volts or less shall be MIL-F019207/2, Type FHL 11U with 1/4 x 1-1/4 inch ceramic tube fuse rated to interrupt 25,000 amperes at 125 volts.
  - 1. Fuse holders for service at over 150 volts but less than 600 volts shall be MIL-F-19207/3, Type FHL 12U with 13/32 by 1-1/2 inch ceramic tube fuse rated to interrupt 100,000 amperes at 600 volts.
  - 2. Fuse holders for the protection of a control circuit transformer which is also provided with an indicating secondary fuse shall be of the double porcelain type having a barrier between the fuses and shall accept the 13/32 by 1-1/2 inch ceramic fuse specified above.
  - 3. Each control circuit transformer shall be protected by two primary fuses and one secondary fuse as a minimum.
- C. Nameplates: Each individual controller, control station, field panel, and control device shall have a nameplate designating the function of the device and its identifying number. All relays, pressure switches, solenoid valves and similar devices mounted outside of their associated motor controller cubicle shall be identified with nameplates. All numbered instruments and devices shall be identified with nameplates.
  - 1. Nameplates shall be made of 1/16-inch thick machine-engraved laminated phenolic having white letters not less than 5/32 inch high on black background. Equipment titles shall be completely spelled out on nameplates as shown on the drawings. The name plate schedules shall be submitted for review and acceptance prior to inscription. Nameplates on steel panels shall be secured with stainless steel drive screws.
- D. Nameplates for identifying relays and devices that are located inside of panels may be of the sandwich phenolic type described above or they may be of white fiber strips marked with the identification in India ink. In large relay panels, relays may be identified with painted designation in clear space adjacent to the relay. Relays shall be identified with number as shown on control diagram and the equipment number which it controls.
- E. Relays, Pilot Devices and Related Control Accessories
  - 1. Relays: Control relays shall be of the heavy-duty solenoid type with contacts having an A600 rating by NEMA standards. Control relays shall have a minimum of four reversible poles at four universal or double-throw poles.
  - 2. Relays rated 300 volts AC may be used only as control circuit interposing relays where voltages are less than 150 volts AC and the 300 volt relay is specified.

3. All control relays shall be rated to "make" 60 amperes and "break" 6 amperes at 120 volts AC and 0.35 power factor lagging and shall be rated 2.0 amperes at 125 volts DC.
- F. Time Delay Relays: Time delay relays shall be electro-pneumatic with appropriate ranges and fully adjustable within the range by a readily accessible control. Snap action switch assemblies shall have contacts rated for more than 10 million operations at 15 amperes, 120 volts AC.
- G. Terminal Blocks: The terminal blocks shall have ample size and capacity to accommodate required loads and shall be of the solderless compression lug type. All terminals shall be numbered and shall be provided with white fiber marking strips.
- H. Door Intrusion Switches: Provide a door intrusion switch on each building and generator door. Provide General Electric Sentrol Model 2507A or equal.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Engineer reserves the right to require minor changes in equipment or its location prior to roughing in, without incurring any additional cost.

### **3.02 Field Quality Control**

- A. After completion of installation, each pilot device shall be individually tested to ensure that the device is properly installed, connected, and operates as required and as specified.

**\*\*END OF SECTION\*\***

**SECTION 16200  
OVERCURRENT PROTECTIVE DEVICES**

**PART 1 - GENERAL**

**1.01 Summary**

- A. Scope: This section provides specifications for all molded case overcurrent protective devices including circuit protective devices, ground fault circuit interrupters, and motor circuit protectors.
- B. Type: The overcurrent protective devices shall be molded case type with adjustable trip settings.

**1.02 References**

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
FS W-C-375	Federal Standard – Circuit Breakers, Molded Case, Branch Circuit and Molded Case Switches
NEMA AB 1	Molded Case Circuit Breakers

**1.03 Submittals**

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

**1.04 Quality Assurance**

A. Performance Requirements

- 1. The frame sizes for overcurrent protective devices shall be as indicated on the contract drawings. The overcurrent protective devices shall be either thermal magnetic or fully magnetic depending on whether the device is protecting a feeder or a motor starter.
- 2. The main circuit breakers shall be 100% rated circuit breaker type and shall be UL listed. An electronic trip unit shall be provided.
  - a. Main Switchboard
  - b. MCC
  - c. Generator
  - d. Load Bank
- 3. Molded case circuit breakers shall be provided with current ratings and pole combinations as indicated on the contract drawings.
- 4. The molded case circuit breakers for protecting feeders shall be thermal magnetic type that provides inversed time delay overload and instantaneous short circuit protection. The molded case circuit breakers in combination type starters shall be fully magnetic type that provides instantaneous short circuit protection. In addition, the circuit breakers shall be ambient temperature compensated. The minimum interrupting rating of the breakers shall be at least equal to the available short circuit current at the line terminal.

- B. Operating Requirements: The interrupting ratings for circuit breakers shall be in accordance and meet or exceed the minimum requirements established by the Short Circuit Study as indicated in

specification section 16011. Lighting panel circuit breakers shall have an interrupting rating of no less than 22,000 amperes rms (symmetrical) at the applied voltage. All other molded case circuit breakers shall be rated at 600 volts, shall meet or exceed the minimum requirements established by the Short Circuit Study and provide the selective coordination requirements demonstrated by the Protective Device Evaluation and Coordination Study as indicated in specification section 16011. For any circuit breakers not covered by Protective Device and Coordination Study, the following minimum interrupting ratings shall be met:

Frame Designation (b)		Maximum Continuous Amperes	Minimum Interrupting Rating	
CH	GE		at 480 volts sym. amps	at 240 volts sym. Amps
HFD	TEL	100	65,000	100,000
HFD	TEL	150	65,000	100,000
HFD	THFK	225(a)	65,000	100,000
HLD	THJK4	400(a)	65,000	100,000
HMC	TPSS	800(a)	65,000	100,000
HNC	TPSS	1,200(a)	65,000	100,000
PB	TPSS	1,600(a)	100,000	100,000

**Notes:**

Interchangeable trips shall be provided.

Frame sizes as shown are Cutler Hammer (CH), General Electric (GE), or equal

**1.05 Delivery, Storage, and Handling**

A. Refer to Section 16010, 1.06 for requirements.

**1.06 Project / Site Conditions**

A. The protective devices will be installed in the main switchboard, motor control centers, control panels and located at a water facility. The ambient temperature is expected to range between 10 degrees F and 115 degrees F. The relative humidity is expected to vary from 10 to 100 percent.

**1.07 Sequencing and Scheduling**

A. Sequencing and scheduling plan shall be provided that minimizes pump station downtime. Note that the pump station must remain operational during all phases of construction. For additional requirements refer to the Special Provisions.

**1.08 Warranty**

A. Refer to Section 17506 for requirements.

**1.09 Maintenance**

A. Refer to Section 17506 for requirements.

## PART 2 - PRODUCTS

### 2.01 Equipment and Materials

- A. In Main Switchboard, the main circuit breaker and branch circuit breakers feeding the motor control centers shall be 100% rated circuit breaker type and shall be UL listed. Circuit breakers shall be of the frame sizes indicated and their ratings shall not be less than the sum of the continuous load plus the non-continuous load. The trip ratings shall be based on the total minimum loads that are summation of the continuous load and non-continuous load. The wire used shall be 90 degree C applied at the 75 degree C capacity. Feeder conductor ampacity shall be equal to or greater than the non-continuous load plus 125% of the continuous load. The circuit breaker units shall have an auxiliary set of double throw contacts to indicate the status of the circuit breakers. Circuit breakers shall be Cutler-Hammer, or approved equal.
- B. The unit shall have solid state trips, current monitors, long time delay, short time delay ground fault trips and instantaneous trip. The circuit breaker shall have an auxiliary set of double throw contacts to indicate the status of the circuit breakers. For mechanical testing, a push-to-test button shall be provided
- C. Molded Case Circuit Breakers
1. Molded case circuit breakers shall be fully enclosed in a molded case and circuit breakers with non-interchangeable trips shall have their covers sealed. Contacts shall be made from a non-welding silver alloy. Arc extinction shall be accomplished by means of arc chutes that consist of a metal grid mounted in an insulated support.
  2. Molded case circuit breakers with current limiting fuses shall be one complete assembly consisting of a molded circuit breaker and current limiting fuse. The above current limiting fuses shall be coordinated with the circuit breaker element for selective operation. The circuit breaker shall not reset until current limiters which have functioned have been replaced and covers fastened. The current limiters shall have visual indicators to indicate which unit needs replacement.
  3. The fully magnetic type circuit breakers shall be adjustable trip magnetic type designed to meet NEC requirements for such devices. The adjustment shall provide instantaneous trip settings in the range of 700 percent to 1300 percent of the lowest full load current for which the unit is rated. Each unit shall be adjusted to the circuit breaker manufacturer's recommended setting for the particular motor full load current. All other characteristics shall be in accordance with the specifications for molded case circuit breakers. The interrupting rating shall be not less than 65,000 amperes symmetrical. Where short circuit current exceeds 65,000 amperes an integrally mounted current limiter shall be provided. Refer to one-line diagrams for available short circuit duties.
- D. Ground Fault Circuit Interrupters
1. Ground fault circuit interrupters (labeled GFI on diagrams) shall be provided in the locations as shown in the panelboards. The circuit interrupters shall be UL listed for the application and shall trip at 5 milli-amperes to protect personnel from electrical shock hazard. The unit shall be of the plug-in type and shall be of the same manufacturer and shall match the other circuit breakers in the panelboard in space requirements and general appearance, except that a test pushbutton shall be provided on the face of each unit and be accessible from the front (similar to the accessibility of the circuit breaker toggle handle).
  2. The neutral for each circuit that is ground fault protected shall be individually brought back with the live leg of the circuit and connected to the neutral pigtail or terminal of the interrupter unit. All wiring in GFI circuits shall be 3/64-inch insulated THWN/XHHW No. 12 AWG minimum. In general, the GFI monitored circuits will be those feeding receptacles in the shop, laboratory, restrooms, operating and outdoor areas of the plant or station and as otherwise noted.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Testing: After the completion of installation, each protective device shall be individually tested to ensure that the device is properly installed, connected and operates as specified and as required.

**\*\*END OF SECTION\*\***

**SECTION 16208  
STANDBY GENERATOR & ACCESSORIES**

**PART 1 - GENERAL**

**1.01 Summary**

- A. Scope: This specification covers requirements for providing a factory built, factory tested, field tested, complete and operable emergency standby power generating system, including all devices and equipment specified herein. All materials and equipment shall be new and of current production of a national firm which manufactures the engine-generator set as a matched unit. The manufacturer, together with its authorized representative, shall have full responsibility for the performance of the generator sets and their accessories.
- B. Type: The generator shall be capable of producing a continuous source of power for the duration of any normal power interruption. These systems shall include, but not be limited to, diesel powered engine driven electric generator with rail-mounted, engine-driven radiator with blower fan type system, engine driven, fans, and a complete exhaust system. Included with the engine generator set shall be a critical type muffler, type 316 stainless steel exhaust piping, flexible exhaust connectors, starting batteries, battery charger, cables, battery racks and all other required items of auxiliary equipment. The unit shall be designed for outdoor installation, with custom level 2 sound-attenuated weatherproof enclosure.

**1.02 References**

- A. Codes and Standards: All equipment and materials, including their fabrication, assembly testing and installation shall meet the applicable requirements of the following codes and regulations.

<u>Reference</u>	<u>Title</u>
AIEE Standard 606	Speed Governing of Engine Generator Units
CAC, Title 19	California Administrative Code Title 19, Public Safety
IEEE 446	Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
NEMA MG1	Motors and Generators
NFPA 37	Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbine
NFPA 70	National Electrical Code. Equipment suitable for use in systems compliant to Articles 700, 701 and 702
NFPA 110	Standard for Emergency and Standby Power Systems, Latest Edition
CCAPCD	Calaveras County Air Pollution Control District Rules and Regulations
UL 142	Standard for Steel Above Ground Tanks for Flammable and combustible Liquids

**1.03 Submittals**

- A. Performance Data: The following performance related documents shall be submitted initially:
  - 1. Manufacturer's standard specification sheets

2. Horsepower curves
  3. Generator curves
  4. Fuel Consumption curves showing 75% and 100% load
  5. Torsional stress analysis and mass elastic system
  6. Motor starting curves
  7. Radiator cooling curves
  8. Warranty certificates
- B. Documents and Shop Drawings: The following equipment descriptive data, operation and installation data, and shop drawings shall be submitted in accordance with Submittals shall comply with the provisions set forth in Sections 01300 and Section 16010 within 30 days of approval of the performance data.
1. Complete Bill of Materials listing equipment furnished and vendor catalog numbers.
  2. Catalog sheets of every major component, marked in such a manner that it identifies the equipment.
  3. Outline drawings of the custom-built sound attenuated housing showing overall dimensions, air intakes and exhaust openings, door dimensions, total weight and the sound rating design criteria.
  4. Assembly drawing detailing the location of the generator set showing the locations of, at a minimum, the following:
    - a. Overall width, length and height
    - b. Fuel connections
    - c. Above Ground Fuel tank location and dimensions
    - d. Electrical connections including breaker locations
    - e. Total weight of the engine-generator set
    - f. Exhaust piping and connections
  5. Complete electrical schematics, description of operation, and control schematics of the automatic operation-manual operation, including the following:
    - a. All A.C. and D.C. schematics
    - b. Control panel layout
  6. A copy of the procedure that will be followed for field testing. The temperature and rating of this equipment is required by the purchaser.
  7. Seismic anchoring requirements
  8. Vibration Isolators
  9. All warranty sheets
- C. Operation and Maintenance Manuals: Operation and Maintenance manuals shall be in accordance with Section 1300 and Section 16010. The operation and maintenance manual shall include:
1. Complete As-Built drawings of the submittal package.
  2. Complete Bill of Materials with all applicable part numbers listed.

3. Complete operator's guide book(s) detailing engine-generator / load bank operation and maintenance procedure required including a lubrication and maintenance chart.
  4. Complete maintenance, calibration, and repair instruction manuals on all major components, electrical schematic, and trouble shooting guide.
  5. Complete parts book detailing all components of the engine-generator set and load bank.
  6. A complete list of recommended consumable parts, their availability and current cost
  7. List of special tools, instruments, accessories, and special lifting devices required for periodic maintenance repair, calibration, and adjustment.
  8. Complete technical and catalog data including product brochures, giving specified information on performance and operating curves, ratings, capacities, characteristics, efficiencies and other data to fully describe items such as the engine, generator, batteries, battery charger, exhaust components, cooling system, jacket water heater, and output circuit breaker. Vendor shall include the name, address, and telephone number of the service organization for the electric generating equipment.
- D. Certified Data: The Vendor shall submit certified copies of factory test reports of the generator. Copies of the factory test reports shall be certified by the manufacturer

#### **1.04 Quality Assurance**

- A. Unit Responsibility: The engine-generator and all ancillary equipment shall be manufactured by manufacturers currently engaged in the production of such equipment. All materials and parts in the unit shall be new and unused, of current manufacture and of the highest grade. The equipment shall be manufactured by a single manufacturer who has been regularly engaged in the production of engine-generator sets for a minimum of ten (10) years for this package (radiator, engine, generator, and control panel configuration). The electric generating system shall be factory built, factory tested, and shipped by a single manufacturer so there is one source of supply and responsibility for warranty, parts, and service.
- B. Manufacturer's Qualifications: The manufacturer is herein defined as a company that offers standard production equipment assembled, tested and supported by authorized dealers. The manufacturer shall have available actual test data on the same configuration of the major components of the package and shall provide a list of twenty (20) installations of such model equipment with the same major components.
- C. Service Location: The manufacturer shall have a local authorized dealer located in County or within 100 mile radius from the project site that can provide factory trained service representatives, required stock of replacement parts, and technical assistance. The dealer must have a service department with twenty-four hour, seven days per week availability.
- D. Safety Standard: The electric generator system provided must meet all requirements of NFPA 110-1987 including design specifications, prototype tests and one step full load pickup. The responsibility for performance of this specification in the entirety cannot be split among individual suppliers of components comprising the system but must be solely assumed by the supplier of the system. The manufacturer shall furnish schematic and wiring diagrams for the engine-generator set.
- E. Standard of the Manufacturer: The engine generator set shall be the manufacturer's standard commercial product with any added features needed to comply with the requirements. All controls shall be the standard of the manufacturer and control parts shall be identified by numbers of the manufacturer. Control systems that are supplied by a sub-vender or subcontractor and not incorporated in the documentation drawings of the generator manufacturer are not acceptable. Additional or better features which are not specifically prohibited by this specification, but which

are part of the manufacturers' standard commercial product shall be included in the generator set being furnished.

- F. Torsional Vibration and Critical Speeds: The mass electric system consisting of engine, flywheel, generator, intermediate couplings and accessories attached to the power train as well as all associated supports and frames shall be designed to be free of dangerous torsional vibrations and critical speeds from 15 percent below idling to 15 percent above the units operating synchronous speed. In addition, the system will have no first, second, third, or half-order critical speeds within plus or minus 20 percent of governed speed. All necessary torsional calculations and evaluations of the mass elastic system shall be under the supervision of a registered professional engineer routinely engaged in this type of work. The engineer shall produce a report providing the results of the analysis and recommendations, if any, for controlling torsional vibration and critical speeds or prototype test results for unit of same type.
- G. Calaveras County Air Pollution Control District (CCAPCD)
  - 1. The engine generator shall be equipped with all necessary devices to meet current CCAPCD requirements for the operation of a standby diesel engine-generator. The vendor shall obtain engine data from the manufacturer and do all the necessary work to submit a complete application, pay the CCAPCD permit fee and perform all tests required by the CCAPCD. The vendor shall begin the permit application process as soon as the Owner has approved the Performance Data Submittal required.
  - 2. Permits required from CCAPCD: Pay permit fees and obtain "Permit to Construct" (in Owner's name) from CCAPCD.
    - a. Provide engine emissions data sheets demonstrating compliance with the current standards of the CCAPCD.
    - b. Obtain "Permit to Construct" application forms from CCAPCD, and fill in all information pertaining to emissions and engine-generator set. Forward one original copy of completed application to Engineer.
    - c. Contractor shall pay for and obtain CCAPCD approval, and shall forward original copy of the "Permit to Construct" to Engineer prior to delivery of engine-generator set.
    - d. Contractor shall install engine-generator set in compliance with conditions in permit, pay any remaining fees, and obtain field approval of CCAPCD inspector. Contractor shall forward original copy of the "Permit to Operate" to Owner's Representative.

### **1.05 Delivery, Storage, and Handling**

- A. Refer to Section 16010 – General Electrical Provisions, 1.07 for requirements.
- B. The generating plant shall be installed as shown on the plans, as a complete factory assembled unit.

### **1.06 Project / Site Conditions**

- A. The generator shall be suitable for outdoor use up to 3700 feet above mean sea level with 2-4 ft of winter snow accumulation. The ambient temperature of the area is expected to vary between 10 degrees F and 110 degrees F and the relative humidity is expected to range between 20 and 100 percent.

### **1.07 Warranty**

- A. The standby power engine-generator unit, and all other equipment items provided under this section shall be guaranteed by the vendor against defects in materials and workmanship, covering 100 percent parts, labor, and travel expenses for a period of five (5) years. The vendor shall be

capable of administering the warranty service on all components of the emergency generator system specified herein.

### **1.08 Maintenance**

- A. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and function tests performed on all systems.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Kohler, No Substitution is allowed

### **2.02 Equipment and Materials**

#### **A. Engine Generator Set**

1. The system shall include the following:
  - a. The generator shall be rated for a minimum continuous standby operation at 500 KW, 0.8 PF, 60 HZ, 3 phase, 3 wire, 480VAC on a continuous standby basis at 1800 RPM. The engine generator shall be housed in a custom-built weather proof, level 2 sound attenuated enclosure. Provide the fuel to this generator from a skid mounted gallon double walled state fuel tank. Kohler Generator Model 500REOZJC was used as basis of design. Kohler model 500REOZVC shall not be acceptable, as District doe not want Volvo engine.
2. The engine generator set as described with all the accessories in place and operating shall meet the following performance requirements:
  - a. The steady state voltage shall be within 15% of 480 volts under all loads and ambient conditions.
  - b. The steady state frequency shall be within 1.5 % of 60 Hz under all load and ambient conditions.
  - c. The voltage shall remain within plus and minus a percentage value, as listed below, of 480 volts when starting motors as required by the specifications and drawings. The voltage shall recover to and remain within the steady state value in 5 seconds after any transient.
  - d. The frequency shall remain within plus or minus 10% of 60 Hz under all load conditions when starting motors as required by the specifications and drawings. The frequency shall recover to and remain within the steady state value in 5 seconds after any transient.

#### **B. Engine**

1. The engine-generator driver shall be a liquid-cooled, diesel fueled engine designed for use with No. 2 diesel fuel. The engine shall be capable of driving the generator with all accessories in place and operating at rated KW at a maximum ambient temperature of 110 degrees F and at an altitude of 300 feet.
2. The design shall be 4 cycle compression ignition diesel, direct injection, turbocharged, and intercooled. Two cycle engines will not be considered. The engine shall be equipped with fuel,

lube oil, and intake air filters, lube oil cooler, fuel transfer pump, fuel priming pump, service meter and gear-driven water pump.

3. The engine shall be capable of driving the generator at this rating on a continuous basis for the duration during the normal utility source interruptions per SAE J1349 conditions.
4. The engine shall be certified by the engine manufacturer as capable of developing the required horsepower at 1800 RPM and driving a generator yielding a KW rating as specified herein.
5. The engine equipment shall include the following:
  - a. An electric starter(s) as required by the manufacturer.
  - b. Gear type, positive displacement, full pressure lubrication oil pump; full flow spin on lubrication oil filters with replaceable spin on canister elements; dipstick oil level indicator.
  - c. Fuel filter with replaceable spin on canister elements and an engine driven mechanical, positive displacement fuel pump all mounted on the engine.
  - d. The engine speed shall be governed by an electronic governor to maintain governed speed at precise isochronous control for rated frequency operation. The frequency at any constant load, including no load, shall remain within a steady band width of plus or minus 0.25% of rated frequency.
  - e. Engine protection devices shall have sensing elements located on the engine to initiate the following preliminary and engine shutdown alarms:
    - 1) Low coolant temperature alarm
    - 2) Low lubrication oil pressure alarm
    - 3) High coolant temperature alarm
    - 4) Low lubrication oil pressure shutdown
    - 5) High coolant temperature shutdown
    - 6) Overspeed shutdown
    - 7) Overcrank lockout
    - 8) Engine running time hour meter
  - f. Provide low coolant level shutdown which will activate high engine temperature lamp and shutdown.
  - g. Engine starter battery charging alternator, with solid state voltage regulator
  - h. Provide engine mounted, thermostatically controlled water jacket heater for engine to aid in quick starting. For the Generator, heater shall be 120V single phase of 90 to 120 degrees F. Water heater shall include U.L. label and be readily accessible.
  - i. Vendor shall provide a valved oil drain line with hose extension for ease of routine oil changes.

#### C. Engine Cooling System

1. The generator set shall be equipped with a rail-mounted, engine-driven radiator with blower fan and all accessories. The cooling system shall be sized to operate at full load conditions and 85 degree F ambient air entering the enclosure without derating the unit and 50/50 anti-freeze mixture.

2. The engine cooling system shall be filled with a minimum concentration of 50% ethylene glycol upon delivery. Flexible cooling water connections shall be furnished for each cooling connection to the engine.
3. The radiator shall be provided with a duct adaptor flange permitting the attachment of an air discharge duct.
4. The generator set supplier is responsible for providing a properly sized cooling system based on the enclosure static pressure restriction.

#### D. Engine Fuel System

1. Generator set supplier shall provide all fuel system, which shall be flexible hose for connection and shall be sized for proper fuel flow to engine.
2. The generator set supplier shall provide a UL listed, painted double-wall skid mounted fuel tank with tank capacity to supply fuel to the engine for a minimum of 24 hours operation at 100% of rated load.
3. Supply piping connections for fuel suction/return lines to fuel storage tank, fuel supply/return lines to engine, and emergency vent. Include local fuel fill, tank drain connection, removable inspection plate with gasket, 'press to test", switch, and fuel level gauge. The following accessories shall be provided; steel rupture basin to contain 150% capacity, fuel in rupture basin switch, high/low fuel level switches for remote annunciation, fuel level transmitter with 4-20mA output, UL 508 control module and fuel strainer.
4. Fuel Filter – In addition to the standard fuel filters provided by the engine manufacture, there shall also be installed a primary fuel filter/water separator in the fuel inlet line to the engine.
5. All fuel piping shall be black iron or flexible fuel hose rated for this service. No galvanized piping shall be permitted.
6. Flexible fuel lines shall be rated 300 degrees F and 100 PSI.

#### E. Engine Exhaust System

1. Vendor shall provide exhaust silencer of the super critical type sized to assure full load operation without excessive back pressure. It shall be mounted within the sound attenuated housing as recommended by the generator set manufacturer. It shall be mounted so that the weight of the silencer is not supported by the engine.
2. The manufacturer shall provide test data certifying that the furnished silencer is in compliance with this performance criteria.
3. The silencer shall be arranged for horizontal mounting with side or end inlet and end outlet. Vendor shall provide a 316 stainless steel bellows type flexible exhaust connector at the engine exhaust outlet to allow for pipe expansion and contraction. Exhaust piping shall be 316 stainless steel.

#### F. Exhaust System Accessories:

1. One 1- inch insulation blanket on all exposed surfaces of the silencer and exhaust piping
2. Exhaust stack rain cap.
3. Condensation drain trap with manual valve.
4. The engine exhaust manifold, turbocharger, and turbocharger elbow shall be provided with an insulating blanket supplied and installed by the generator set manufacturer.

5. Brackets, rods, fasteners, and other items to secure the silencer in place. Insulation shall be provided at points of contact with combustible materials to prevent heat radiated by any hanger rods from posing a fire hazard.

#### G. Generator

1. The AC generator shall be brushless, revolving field type, coupled to the engine flywheel through a flexible deriving disc for positive alignment. The generator housing shall bolt directly to the engine flywheel housing. The generator housing shall have a single ball bearing support for the rotor. The rotor shall be dynamically balanced up to 25% overspeed. The generator shall be 12 lead synchronous, four pole, drip-proof, and air cooled.
2. The stator windings shall have skewed laminations of electrical grade steel. The stator winding shall be of 2/3 pitch design to eliminate the third harmonic wave form distortion and minimize the harmful neutral circulating current when operating in parallel. The wave form harmonic distortion shall not exceed 5 percent total RMS measured line to line at rated load and single harmonic maximum of 3 percent of rated voltage.
3. The rotor shall be layer wound mechanically wedged winding construction with thermo-setting epoxy between each layer plus a final coat of epoxy for moisture and abrasion resistance. Amortisseur windings shall be integral with the rotor support. The rotor shaft bearing shall be shielded type with provisions for easy servicing through grease pipes which extend to the exterior of the generator frame. The bearing shall be designed for a minimum B-10 bearing life of 40,000 hours.
4. The rotating brushless exciter shall incorporate a full wave, three phase, rotating rectifier with hermetically sealed, metallic type, silicon diodes to supply the main field excitation. A multi-plate selenium surge protector shall be connected across the diode network to protect it against transient conditions.
5. Sub-transient reactance shall not exceed 10 percent.
6. Radio interference: Alternator and voltage regulator shall meet the provisions of BS 800 and VDE Class G and N.
7. All system components including the rotor, stator, and exciter shall be Class H as recognized by NEMA. The temperature rise measured by resistance at full load shall not exceed 80 degree's F. The main generator and exciter insulation shall be suitably impregnated for operation in severe environments of sand, salt water, and sea spray.
8. A manual reset exciter circuit breaker sensing overload or short circuit in each of the generator output legs shall be mounted on the generator to protect the generator from any over-current condition.
9. Current boost: Provide Permanent Magnet Generator (PMG) for excitation power, isolation and 300% current for 10 seconds.
10. If a short circuit occurs, the generator shall be capable of supporting 300% rated current for 10 seconds for selective tripping of down line protection devices. A current sensing magnetic breaker will protect the exciter and trip after 10 seconds during the current boost condition. Current boost systems using electronic means or CT's are not acceptable.
11. AC output leads shall be brought out to the field connection bus bars through removable plates on either side of sheet metal output box and terminated on the output circuit breaker.
12. The generator shall be furnished with an end mounted, ventilated load connection box such that the load connectors can enter the bottom of the junction box.

#### H. Voltage Regulator

1. The voltage regulator shall be of solid state construction, with three phase RMS sensing, asynchronous pulse width modulated, temperature compensated with over-voltage and over excitation protected. Over-voltage protection shall shut down the regulator output on a sustained over voltage of one (1) second. Over-excitation protection shall shut the regulator output if overloads exceed ten (10) seconds. The regulator shall allow frequency output to decline to 58-59 Hertz before correcting the output voltage. It shall be mounted inside the generator terminal box or in the control cabinet. A built in voltage adjusting rheostat shall provide 5% voltage adjustment.
2. The voltage regulation shall be plus or minus 0.5% of rated voltage for any constant load from no load to rated load. The regulator printed circuit board and power control diodes shall be hermetically sealed for moisture protection.
3. For any addition of load up to and including a 75 HP code G motor, the voltage dip shall not exceed of rated voltage. The voltage shall recover to and remain within the steady bank in not more than 4.5 seconds.
4. The frequency regulation from no load to rated load shall be in accordance with that defined by the engine governor performance. For any addition of load up to 90% of rated load, the frequency shall recover to the steady state frequency band within 7.0 seconds.
5. The balanced telephone influence factor (TIF) shall not exceed 50

## **2.03 Components and Accessories**

### **A. Generator Control Panel**

1. Generator to be furnished with Kohler Decision-Maker 6000 microprocessor based controller with digital display and keypad, no equal." The generator NEMA 1 control panel shall be mounted on the generator complete with: recessed front panel hinged at the bottom, rubber isolation vibrators, and grommets control wire exit hole. The control panel shall have surge suppression for protection of solid state components. Vendor shall supply a front control panel illumination lamp with ON/OFF switch, alarm horn and silence switch. Control panel accessories shall include the following instruments:
  - a. A.C. voltmeter, 2% accuracy, 2-1/2", 0-480 V
  - b. A.C. ammeter, 2% accuracy, 2-1/2", 0-600 A
  - c. Dial type frequency meter, 0.5% accuracy.
  - d. Ammeter, voltmeter phase selector switch with OFF position.
  - e. Phase selector switch with OFF position for meter display of current and voltage in each generator phase.
  - f. D.C. running time meter, non resettable
  - g. D.C. battery charging voltmeter
  - h. Engine water temperature gauge
  - i. Shutdown indicators for low oil pressure
  - j. High water temperature
  - k. Engine over-speed
  - l. Solid state voltage adjustment with +/- 5%
2. The engine-generator control shall have automatic remote start capability. A three position switch (RUN-STOP-AUTO) shall start the engine in the RUN position, stop the engine in the

STOP position, and allow the engine to start and run by closing a remote contact, and stop when opening the remote contact in the AUTO position.

3. The engine-generator control shall include a cranking cycle consisting of three cranking cycles with rest periods. Failure to start after three attempts (75 seconds) shall shut down and lock out the engine.
4. The engine-generator control shall shut down and lockout the engine upon:
  - a. Overcrank
  - b. Overspeed
  - c. Low oil pressure
  - d. High engine temperature
5. The control panel shall be provided with a DC powered twelve light monitor labeled as follows:

a. Run:	Red
b. Low oil pressure (pre-alarm):	Amber
c. High engine temperature (pre-alarm):	Amber
d. Low engine temperature:	Amber
e. Low oil pressure (shutdown):	Red
f. High temperature (shutdown):	Red
g. Overcrank:	Red
h. Overspeed:	Red
i. Not in automatic:	Red
j. Circuit breaker trip/open:	Red
k. High battery voltage:	Red
l. Low battery voltage:	Red
6. Panel mounted switches shall be provided which will reset the engine-generator monitor and test all lamps, operation of the shut down circuits shall be independent of the pre-alarm circuits.

#### B. Starting and Utilities

1. The engine shall be equipped with a 24 Volt electric starting system of sufficient capacity to crank the engine-generator unit at a speed which will allow satisfactory starting of the engine.
2. Lead acid batteries shall be furnished having sufficient capacity for nine (9) cranking attempts and capable of cranking the engine for at least 40 seconds at firing speed in the ambient temperature of 110 degree F. A battery rack and necessary gravity of the fully charged battery "acid" shall not exceed 1.220 at 77 degree F. Provide insulated stranded copper conductors connecting the battery to the generator electric starting motor.
3. An automatic float/equalize type battery charger shall be provided, installed, and wired on the generator set. Connections to the battery shall be solid wired (clip on type not acceptable). Input voltage shall be 120 volts AC. Charger shall be UL listed. Output capacity shall be 10amps at 24 volts DC. Features shall include the following:
  - a. Low battery voltage alarm contacts, set to close if the battery voltage drops below 24 volts
  - b. Neon light to indicate the selector switch is in the "equalize" range

- c. DC voltmeter
  - d. DC ammeter
  - e. AC circuit breaker on input line
  - f. DC circuit breaker on output
  - g. Battery failure alarm contacts, set to close if AC power is lost to charger. Battery charger enclosure shall be NEMA 1 construction and arranged for convection cooling.
4. Provide 100% rated main output circuit breaker, amp rating as shown on the single line diagram, UL, 65,000 AIC, 600 Volt, molded-case, solid state type with inverse time delay trip overload and instantaneous trip on overcurrent. Circuit breaker shall be installed and wired include breaker trip and breaker open contacts.
  5. Air Restriction Indicator: The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.
  6. Block Heater: The block heater shall be thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.
  7. Crankcase Emission Canister: The engine shall have a crankcase emission canister. The emission canister prevents crankcase oil vapor from escaping into the air to prevent environmental pollution and fouling of the radiator.
  8. Dry Contact Kit: The 10 Dry Contact Kit shall provide normally open and normally closed, gold-plated contacts in a form C configuration to activate warning devices and other customer-provided accessories allowing remote monitoring of the generator set. Typically, lamps, audible alarms, or other devices signal faults or status conditions.
  9. Duct Flanges: A radiator duct flange to provide a convenient connection to duct work for the radiator discharge air shall be included.
  10. Failure Relay:
    - a. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, overcrank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
    - b. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
    - c. Once energized the relay shall remain latched until the system is reset by the main controller switch

## **2.04 Fabrication**

### **A. Fuel Storage System**

1. The Fuel Storage System shall be subbased mounted, double-wall, diesel fuel-oil tank complying with UL142 and capable of supplying 48-hours of continuous full load operation." The subbase fuel tank shall be "State Subbase Fuel Tank" including IBC seismic certification.
2. The Contractor shall provide a UL listed double containment skid mounted fuel storage tank with fuel level transmitter, low fuel level switch and fuel storage tank leak sensor for monitoring by the pump station control panel. Fuel Tank Instrumentation shall terminate in the generator control panel with terminal blocks for each signal for connection to the pump station control panel PLC.

### **B. Custom-Built Weather-Proof, Sound Attenuated Enclosure**

1. The complete engine-generator set and all components shall be mounted in a custom-built weatherproof, flat roofed, and rodent protected enclosure, with pad-lockable doors designed so the unit can operate at full load without overheating and with all the doors closed. The enclosure manufacturer shall be regularly engaged in the design and manufacture of generator housings and shall have an acoustical engineer on staff.
2. The enclosure shall be furnished with Basic Electrical Package (BEP) including 120 volt GFIC receptacles, LED lights, and wall switch. Furnish enclosure with motorized air inlet, gravity air outlet, block heater, block heater wiring kit, battery charger wiring kit, enclosure heater and enclosure heater wiring kit.
3. The enclosure shall be designed so that the muffler will mount horizontally inside the enclosure, and radiator air will be provided with a suitable rain shield to prevent the entry of rain water into the house interior.
4. The enclosure shall be Kohler Sound Enclosure (Level 2) with maximum sound pressure of 76 dBA at 23 feet measured at 8 positions around the perimeter of the unit with the generator running at full load. Enclosure design shall include a vertically directed exhaust to minimize sound.
5. The wind loading shall be 125 MPH.
6. Seismic Rating IBC Rated –Reference Section 16010 Project Site Conditions.
7. The enclosure shall be painted, have hinged doors, and shall be constructed of 12 gauge steel. The generator enclosure skin material will be carbon steel. The enclosure frame material will be A-36 carbon steel structural tubing and channels. Outer walls will be 4" consisting of 4 lbs per cu/ft density mineral wool with 2 mil poly liner.
8. Baffles will include intake acoustical silencer and discharge acoustical silencers of Galvanneal Construction.
9. The enclosure shall include valved external drain extensions for coolant and lubricating oil.
10. Backdraft Damper Discharge end, gravity type
11. Door shall be 36" Wide Double seal with stainless steel hinges and bolting hardware.
12. Chrome plated refrigerator type latches w/ inside release.
13. Space shall be provided in front of the housing for a cable reel. A door suitable for outdoor conditions shall be provided over this space

## **2.05 Load Bank**

- A. Provide a 480 volt three phase load bank system complete with contactor and controls for the generator. The load bank shall be the air cooled independently mounted type, installed adjacent to the generator as shown on the contract documents. The load bank system shall be operated from the load bank control panel that is located within the load bank enclosure. The load bank shall be contained in the separate weatherproof enclosure with a vertically directed exhaust.
- B. The load bank shall be provided with a control mode selector switch control panel with three positions. In the "automatic" position, the system will be automatically operate upon loss of utility power. In the "off/reset" position, the system will be completely locked-out or shut down. In the "manual" position, the load bank can be used to test and exercise the generator system. The load bank shall be capable of applying a load resistance equal to at least 60 percent of the generator KW rating in a minimum of 5 steps.
- C. Size the load bank for 60% to 100% of the generator rating. Wire load bank for a minimum of five load steps.

- D. Load resistors shall have a three-year warranty against defects in materials and workmanship.
- E. Load resistors shall be constructed of heavy gauge steel and mounted on field removable tray with connections brought to the exterior of the tray using ceramic and stainless steel hardware.
- F. Circuit breaker combination magnetic contactor shall be provided. Fuses shall be provided for the control power transformer and circuit wiring. Provide a control panel to house all switches and controls for the load bank system. The control panel shall include an automatic load bank controller and associated operator controls. The controls shall including the following:
  - 1. Main circuit breaker
  - 2. Fuse protection for control circuits
  - 3. 480-120-volt control power transformer
  - 4. Full voltage, non-reversing magnetically held contractor for each resistive load step
  - 5. Fuse protection for each resistive load step
  - 6. Start-stop pushbuttons to enable load bank and to automatically de-energize load bank upon loss of power
  - 7. Load step switch to energize incremental load steps
  - 8. Load bank controls shall be enabled only when the generator control panel function switch is in "manual" or "auto"
  - 9. Solid state generator exercising timer (Paragon #EC71/185 or equivalent) which can be programmable to exercise the generator for one minute to 24 hours per day (in one minute increments) for 0 to 31 day cycles. Exercising timer control shall start the generation and when operating temperature is reached, incrementally load the generator to the full load bank capacity. When the programmed running time has expired, the load bank shall be taken off line and the generator allowed to run unloaded for an adjustable cool down period of 0 to 10 minutes. After the cool down period, the generator shall be shut off. In the event of a utility power loss during exercising, the load bank shall be taken off line.
  - 10. Indicating lights which indicates that the generator has started because of generator exercising, not loss of utility power.
  - 11. "Hand-Off-Auto-Exerciser" Selector Switch: In the "Hand" mode, the exerciser timer shall be disable and only manual control shall be enabled. In the "Auto" mode, the load bank is on-line and continuously operative whenever the generator runs, exerciser control disabled, and manual control disabled. In the "Exerciser" mode, the exerciser timer shall be enabled, automatic control disabled and manual control disabled. In the "Off" mode, both the manual and exerciser controls shall be disabled.
- G. In automatic mode, the load bank is to be on-line and continuously operative whenever the generator runs. The load bank shall provide a component of the total power source load and shall be automatically variable in response to dynamic total load demands upon the power source.
- H. The automatic controller shall include control logic, solid-state sensors and time delays which shall act to apply/remove load bank component in multiple steps in response to dynamic output of the power source.
  - 1. The automatic controller shall function to maintain total load upon the power source within a present bandwidth by adding load bank load component as external load component drops and removing load bank component when external load rises.
  - 2. The automatic load bank shall sense load in amperes.

3. Full manual control of the load bank shall be restored when the mode selector switch is placed in the "manual" position.
  4. The automatic controller shall include a solid state load sensor with level and time delay adjustment and output contacts for each load step.
  5. The automatic control system shall include one (1) current transformer installed in the associated main distribution panel around the conductors of one phase at the load side of the transfer switch.
- I. The load bank shall include a comprehensive protection system to protect against overheating. The system shall function to disconnect the load elements from the power source and activate an alarm upon sensing a loss of cooling airflow, or exhaust air temperature greater than 300° F.
  - J. Load elements shall be UL listed, labeled or recognized, totally enclosed, sealed and weatherproof with an electrically grounded outer sheath such that the element cannot be electrically short-circuited by external foreign objects and personnel are protected against accidental electrical shock. Elements shall be individually replaceable. Open wire type elements in which the electrically live conductors are exposed and which can be short-circuited to each other or to ground by foreign objects or by the breakage of an element or an element support shall not be permitted.
  - K. Load bank power wiring shall be 150 degrees C insulated. The wire shall be sized so the maximum rating at the ampacity applied is less than 80% of its maximum rating at its ambient rating.
  - L. Main terminals shall be barrier type power terminal blocks with compression type terminals to accept stranded building wire. Provide chassis ground stud with compression type terminal.
  - M. Control wiring shall be 105 degrees C insulated. All control wiring shall have wire numbers that are indicated on the wiring diagrams.
  - N. The load bank shall be manufactured by Avtron Manufacturing (Cleveland, Ohio), Simplex (Chicago, Illinois), Load Technology, Inc. (La Mirada, California), or equivalent

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.
- B. Design Prototype Tests - Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:
  1. Maximum power (kW)
  2. Maximum motor starting (kVA) at 35% instantaneous voltage dip
  3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
  4. Governor speed regulation under steady-state and transient conditions
  5. Voltage regulation and generator transient response
  6. Harmonic analysis, voltage waveform deviation, and telephone influence factor

7. Three-phase short circuit tests
8. Alternator cooling air flow
9. Torsional analysis to verify that the generator set is free of harmful torsional stresses
10. Endurance testing

C. Factory Testing

1. Perform factory tests prior to shipment to jobsite. Include the following:
  - a. Demonstrate proper operation of all safety devices and test alarm and shutdown circuits by simulating fault conditions.
  - b. Conduct load tests utilizing resistive load banks as follows:

<u>LOAD</u>	<u>HOURS</u>
1/2	1
3/4	1
Full	4

- c. At the end of two hours at full load, the engine-generator shall be block loaded from no load to full load a total of two times, and the voltage dip and frequency dip shall be recorded by a strip chart recorder. Record current, voltage, frequency, water temperature, lube oil pressure, and lube oil temperature every 15 minutes.
2. The Engineer shall witness the factory test of engine-generator set. The Contractor will be responsible for all travel costs for personnel witnessing factory tests that are required outside of a 100 mile radius from the project site. Provide a written notification to the Engineer at least ten (10) working days in advance of the factory test. Written notice shall include a written test procedure.
3. Submit three copies of the Factory test report to Engineer
4. Contractor shall provide No. 2 diesel for all startup and testing, minimum of 500 gallons.

**3.02 Installation**

- A. The unit shall be installed in accordance with the manufacturer's directions.
- B. The Contractor shall coordinate the construction of engine-generator set foundations and piping systems with the generator set manufacturer's written requirements.
- C. Foundation, anchor bolt layouts, and piping may have to be modified from those shown on the plans. Such work shall be at the Contractor's expense. Anchor bolts and support for exhaust system shall be determined by the required structural calculations.
- D. Installed location of unit shall comply with the required working clearances in front of circuit breakers, load bank controls and other electrical equipment that will require service while energized per the NEC.
- E. Load bank design and installed position shall allow the removal and replacement of individual elements without removal of radiator, or ductwork.
- F. Grounding and bonding shall be completed as required by applicable sections of the NEC.
- G. Battery cables shall be sized by calculations or catalog data showing wire gauge and maximum length of battery cables for the cold cranking amp rating of the engine-generator set.
- H. Installation of exhaust system shall be coordinated to avoid conflict or heat exposure to lights and fire detection or suppression systems. Exhaust insulation blankets shall be installed.
- I. Check torque of bolted connections.

- J. Check electrical connections for proper phase relationship.
- K. Fill cooling system with an antifreeze and water solution per the manufacturer's recommendation.
- L. Fill the tank with No. 2-D diesel fuel meeting ASTM 975-60T. After field testing is complete, refill the tank.
- M. Piping - Pitch horizontal runs of exhaust pipe away from the engine. Provide condensate traps with petcocks or valves at low spots in the exhaust system.
- N. Contractor shall provide an installation report stating that all installation items noted under Section 3.02 are complete including copy of structural calculations, battery cable calculations, torque settings used for bolted connections, and proper phase relationship.

### **3.03 Field Quality Control**

#### **A. Manufacturer's Representative**

- 1. The services of a qualified representative of the manufacturer shall be furnished to inspect the installation, place it in operation, make any necessary adjustments, and instruct the plant personnel in its operation and maintenance. Instruction of plant personnel shall be in accordance with Section 01661. A minimum of four hours training shall be provided.

#### **B. Start-Up and Field Testing**

- 1. Submit operation and maintenance manuals to Engineer at least ten (10) working days prior to the start-up and field testing.
- 2. Schedule: Provide written notice to the Engineer of the scheduled start-up and field test date at least ten (10) working days prior to test date. Startup and field testing shall be conducted only on a Tuesday, Wednesday, or Thursday. All field tests shall be witnessed by Engineer. Written notice shall include a written test procedure.
- 3. On completion of the installation the manufacturer's distribution representative shall perform an installation check, startup, and building load test and who shall thoroughly inspect, operate, test, and adjust the equipment. The inspection shall include the soundness of all parts, the completeness of all details, the proper operation of all components with special emphasis on safety devices, the correctness of settings, proper alignments, and correct phase rotation to match other sources. Provide a report of all necessary adjustments, corrections, or findings. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:
  - a. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
  - b. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, etc.
  - c. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
  - d. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test

4. Emissions Cold Start Test: Test time and conditions shall be coordinated to include exhaust emissions startup test witnessed by Field Inspector from local Air Quality Management District. Emissions test shall be done first to be at cold start conditions.
5. Inspection Report: On completion of the installation, the initial start-up shall be performed by a factory-trained service representative of the engine supplier, who shall thoroughly inspect, operate, test, and adjust the equipment. The inspection shall include the soundness of all parts, the completeness of all details, the proper operation of all components with special emphasis on safety devices, the correctness of settings, proper alignments, and correct phase rotation to match other sources. Inspection shall also be conducted by County Inspector per Fire Code. Provide a report of all necessary adjustments, corrections, or findings.
6. Field Power Failure and Transfer Test: Simulate power failure by tripping the main breaker and demonstrate complete manual and automatic start, load, unload, and stop sequence of the engine-generator. Conduct test 2 times.

#### C. Training

1. Provide 4 hours of training conducted by factory-trained service representative of the engine supplier. Provide written notice to the Owner of the scheduled training date and including an agenda of training topics at least five (5) working days prior to test date.

**\*\*END OF SECTION\*\***

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# SECTION 16250 MOTOR CONTROL CENTERS

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This Section specifies motor control centers (MCC) furnished under this contract.
- B. Type: The motor control centers shall be of the mechanical group type or a combination of motor controllers, with feeder top and/or other units arranged in a convenient assembly. Motor control centers shall be Eaton, Allen Bradley or equal.

### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
NEMA ICS-1	General Standards for Industrial Control and Systems
NEMA ICS-2	Standards for Industrial Control Devices, Controllers, and Assemblies
NEMA ICS-18	Industrial Control and Systems: Motor Control Centers
NFPA 70	National Electric Code
UL 508	Industrial Control Equipment
UL 845	Motor Control Centers

### 1.03 System Description

- A. Performance and Design Requirements
  - 1. General: The motor control centers shall contain equipment to start, stop and monitor the status of the various groups of motors from a convenient central assembly. In addition, equipment shall be provided to protect motors, machines and operators. Connection points shall be provided from the common horizontal power bus to the operating units. The MCC shall be suitable for connection to an available fault as shown on MCC single-line diagrams.
  - 2. Unit Responsibility: The motor control centers shall be the product of a manufacturer regularly engaged in the manufacturer of motor control centers and associated control equipment and overcurrent devices.
  - 3. Operating Requirements
    - a. Voltage shall be 480 volts, 65,000 AIC, three phase, 60 hertz.
    - b. Number of wires shall be 3 wire or 4 wire as indicated on the single line diagrams of the Contract Drawings.
    - c. Main Bus Rating shall be as indicated on the single line diagrams of the Contract Drawings.
  - 4. Incoming feeder line connection shall be in accordance with the MCC elevation and single-line drawings.

5. Power shall be provided to the motor control center compartments from the main bus by vertical bus bars, which shall have minimum 300 amperes rating unless underground feeder requires greater capacity. A ground bus with appropriate lugs shall be provided across the bottom of the motor control center

#### **1.04 Submittals**

- A. The Submittals shall comply with the provisions set forth in Sections 01300 and 16010. Additionally, the submittals shall consist of the following data, drawings and descriptive material:
  1. Manufacturer's qualifications
  2. Master Drawing Index
  3. Front view elevation.
    - a. Note that the overall length of the motor control center shall not exceed the overall length of the motor control elevation as shown on the contract drawings.
    - b. If submitted motor control center manufacturer is an "or equal" and cannot meet the overall length of the motor control center elevation shown on the contract drawings, the contractor shall provide one of the two named manufacturers.
  4. Floor Plan
  5. Top View
  6. Unit Wiring Diagrams
  7. Nameplate Schedule
  8. Conduit Entry/Exit Locations
  9. Assembly ratings including short-circuit rating, voltage and continuous current.
  10. Layout wiring diagrams and shop drawings
  11. Cable Terminal Sizes
  12. Major component ratings including voltage, continuous current, and interrupting ratings.
  13. Complete catalog data, including manufacturer's catalog number, function, size, and complete applicable data for each item of equipment.
- B. All submittals shall be prepared by the System Integrator. Factory supplied drawings including bill of materials, motor control center elevations, and wiring diagrams are not acceptable.

#### **1.05 Quality Assurance**

- A. A system integrator shall be retained by the contractor to purchase and customize the motor control centers to meet the wiring and control requirements of the contract diagram. Motor control centers provided directly from the manufacturer will not be accepted. The system integrator shall be Tesco, Telstar, KBL Associates or approved equal.
- B. Motor control centers shall be built in strict accordance with the overall sizing and component layouts as detailed on the Drawings and no deviations will be allowed without prior approval of the Engineer.
- C. Any special protection relays for the pumps or motors that are required by any pump or motor manufacturer shall be incorporated into the motor starter control circuits at no extra cost to the Owner. Contractor shall be responsible for coordination of these special protection relays between the pump, motor and motor control center manufacturers or suppliers.
- D. Provide Seismic tested equipment as follows:

1. The equipment and major components shall be suitable for and certified by actual seismic testing to meet all applicable seismic requirements of the latest California Building Code (CBC).
  2. The Project Structural Engineer will provide site specific ground motion criteria for use by the manufacturer to establish SDS values required.
  3. The IP rating of the equipment shall be 1.5
  4. The Structural Engineer for the Site will evaluate the SDS values published on the Manufacturer's website to ascertain that they are "equal to" or "greater than" those required for the Project Site.
  5. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
    - a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon the above criteria to verify the seismic design of the equipment.
    - b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- E. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra

#### **1.06 Delivery, Storage, and Handling**

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- B. Refer to Section 16010 for requirements.

#### **1.07 Project / Site Conditions**

- A. The motor control centers shall be installed either indoors, as noted on the plans, in a water facility. Temperatures are expected to range from 10 degrees F to 115 degrees F. Relative humidity should range from 10 percent to 100 percent. In some installations, the equipment will be subjected to small amounts of dust and may operate in damp rooms that are not force ventilated.

#### **1.08 Sequencing and Scheduling**

- A. Sequencing and scheduling plan shall be provided that minimizes pump station downtime. Note that the pump station must remain operational during all phases of construction. For additional requirements refer to the Special Provisions.

#### **1.09 Warranty**

- A. Refer to Section 17506 for requirements.

#### **1.10 Maintenance**

- A. Refer to Section 17506 for requirements.
- B. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component,

### C. Overload Heater Elements

1. All motor starters shall be furnished with overload heater elements. As mechanical equipment arrives, the Electrical Contractor shall check the nameplates for FLA and verify that the appropriate overload element for the furnished motor is installed.

### D. Standby Components

1. Fuses: A set of spare fuses shall be provided. It shall include five fuses for every rating used in the delivered equipment.
2. Lamps: A set of replacement lamps shall be provided for each motor control center. At least 10 percent of each type of lamp used in MCC assembly shall be provided as spares.
3. Two (2) pilot device contact blocks of each type supplied.
4. Supply all spares sealed in plastic bags, labeled with part numbers in a plywood storage box.

- E. Devices and Instruments: Where a spare unit is indicated on the drawings, it shall be complete combination starter of the type and size shown. Where a future unit is indicated on the drawings, it shall be provided with all facilities except the draw out unit. The future compartment door shall be provided with covered cutouts for the devices shown. Spare and futures are shown on the MCC elevation drawings.

## PART 2 - PRODUCTS

### 2.01 Manufacturers

- A. Make like items of equipment the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service. Motor Control Centers shall be Eaton, Allen Bradley, Square D or equal.

### 2.02 Ratings

- A. The Motor Control Center(s) shall be 600-volt class suitable for operation on a three-phase, 60 Hz system. The system operating voltage and number of wires shall be as indicated on the drawings.

### 2.03 Construction

- A. Motor Control Center(s) shall be Allen-Bradley 2100 NEMA with ArcShield, Eaton Freedom Flashgard, Square-D Model 6 Arc Resistant(AR) or equal.
- B. Structures shall be totally enclosed, dead-front, free-standing assemblies. They shall be 90 inches high and 16 inches deep for front-mounted units and 21 inches deep for back-to-back mounted units. Structures shall contain a horizontal wireway at the top 9 inches tall, isolated from the horizontal bus via metal barriers and shall be readily accessible through a hinged cover. Structures shall also contain a horizontal wireway at the bottom 9 inches tall that is open to the full rear of the structure. Adequate space for conduit and wiring to enter the top or bottom shall be provided without structural interference.
- C. Compartments for mounting control units shall be incrementally arranged such that not more than six (6) Size 1 or Size 2 starters for front-mounted only can be mounted within each vertical structure. Guide rails shall be provided.
- D. A vertical wireway with minimum of 35 square inches of cross-sectional area shall be adjacent to each vertical unit and shall be covered by a hinged door. Wireways shall contain steel rod cable supports.
- E. All full voltage starter units through NEMA Size 5 and all feeder breakers through 400 Amp shall be of the draw-out type. Draw-out provisions shall include a positive guide rail system and stab

shrouds to absolutely ensure alignment of stabs with the vertical bus. Draw-out units shall have a tin-plated stab assembly for connection to the vertical bus. No wiring to these stabs shall extend outside of the draw-out unit. Interior of all units shall be painted white for increased visibility. Units shall be equipped with side-mounted, positive latch pull-apart type control terminal blocks rated 600 volts. Knockouts shall be provided for the addition of future terminal blocks. In addition, a master terminal block, when Type C wiring is specified, shall be draw-out and shall be located in the bottom wireway, readily accessible through a hinged cover. All control wire to be 14 gauge minimum.

- F. All draw-out units shall be secured by a spring-loaded, quarter turn, indicating type fastening device located at the top front of the unit. With the exception of the dual-mounted units, each unit compartment shall be provided with an individual front door.
- G. An operating mechanism shall be mounted on the primary disconnect of each starter unit. It shall be mechanically interlocked with the unit door to prevent access, unless the disconnect is in the "OFF" position. A defearer shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. A second interlock shall be provided to prevent removal or reinsertion of the unit while in the "ON" position. Padlocking facilities shall be provided to positively lock the disconnect in the "OFF" position with up to three (3) padlocks with the door open or closed. In addition, means shall be provided to padlock the unit in a partially withdrawn position with the stabs free of the vertical bus.

## **2.04 Bus**

- A. Each structure shall contain a main horizontal silver-plated copper bus, with minimum ampacity of 600 amperes or as shown on the drawings. The horizontal bus shall be rated at 65 degrees C temperature rise over a 40 degrees C ambient in compliance with UL standards. Vertical bus feeding unit compartments shall be tin-plated copper and shall be securely bolted to the horizontal main bus. All joints shall be front-accessible for ease of maintenance. The vertical bus shall have a minimum rating of 600 amperes or as shown on the drawings. Both vertical and horizontal bus shall be fully rated; but shall not be tapered. Vertical bus shall not be reduced rated via center feeding, and be fully rated, top and bottom, from centerline bus.
- B. Isolation of the vertical bus compartment from the unit compartment shall be by means of a full height insulating barrier. This barrier shall be a single sheet of glass-reinforced polyester with cutouts to allow the unit stabs to engage the vertical bus every 6 inches. Provide snap-in covers for all unused openings.
- C. Buses shall be braced for 65,000 amperes RMS symmetrical.
- D. A silver-plated copper ground bus shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the motor control center. The ground bus shall be located in the bottom horizontal wireway.
- E. Each structure shall contain tin-plated vertical ground bus rated 300 amperes. The vertical ground bus shall be directly connected to the horizontal ground bus via a tin-plated copper connector. Units shall connect to the vertical bus via a tin-plated copper stab

## **2.05 Wiring/Terminations**

- A. Wiring shall be NEMA Class II, Type B.

## **2.06 Motor Controllers**

- A. Combination starter units shall be full-voltage non-reversing, unless otherwise shown, and shall utilize Eaton type HMCP Motor Circuit Protectors.

1. Each combination unit shall be rated 65,000 AIC symmetrical at 480 Volt. The HMCP shall provide adjustable magnetic protection and be adjustable to 1700% motor nameplate full load current to comply with NEC requirements. All HMCP combination starter units shall have a "tripped" position on the unit disconnect and a push-to-test button on the HMCP. Type HMCP motor circuit protectors through size 4 shall include transient override feature for motor inrush current.

## B. Motor Starters

1. Magnetic starters through NEMA Size 3 shall be equipped with double-break silver alloy contacts. The starter must have straight-through wiring. Each starter shall have a minimum of one (1) normally open auxiliary contact.
2. Coils shall be of molded construction through NEMA Size 3. All coils to be color-coded through size 5 and permanently marked with voltage, frequency and part number.
3. Solid-State Overload Relay- C441
  - a. Where indicated on the drawings, use a microprocessor-based Overload Relay (OLR) in each starter and/or where indicated on the drawings for protection, control, diagnostics and monitoring of the motors. The OLR shall be Eaton type C441 (Motor Insight) overload and monitoring relay. The OLR shall meet UL 1053, UL 508, CUL and CSA, and IEC standards
  - b. The OLR shall not require external current transformers for motor applications from 1 to 90 amperes FLA. Where larger motors are involved, external current transformers shall be used
  - c. The OLR shall be rated for application of 660VAC and less
  - d. The OLR shall have the following motor control functions:
    - 1) 1—Fault relay, Form B, NC contact with a rating code of B300 per UL 508.
    - 2) 1—Programmable Auxiliary Relay, Form A, NO contact with a rating code of B300 per UL 508.
    - 3) Programmable auxiliary relay allows for user defined fault identification, fault alarming and fault prioritization, including all protection faults including but not limited to: ground fault, jam, phase imbalance, high and low power,
    - 4) 1—External remote reset allowing for a 120VAC wired remote reset
    - 5) 2—Trip & Reset status indicating LEDs
    - 6) 1 – Door mounted remote display manual reset button
    - 7) 1 – Door mounted remote display Manual trip button
  - e. The OLR shall be capable of accommodating external current transformers with ranges from 150:5, 300:5, and 600:5 amperes through a settable CT multiplier on the device for FLAs above 90 amps.
  - f. The OLR shall draw its control power from separate source 120 VAC supply not requiring line power to operate it. The OLR shall be suitable for between 47 Hz and 63 Hz.
  - g. The OLR shall have selectable trip classes from 5-30; stepped by ones.
  - h. The OLR shall be equipped with a dedicated door mounted operator-interface (OI)/ display interface panel. The OI shall have a seven-segment 3-digit LED display for control, programming, monitoring, diagnostic and alarming functions.
  - i. The overload relay shall be completely configurable without the use of any proprietary software tool

- j. The overload relay shall be completely configurable through the use of available communications/industrial network
- k. The OLR relay shall have a minimum of a 10-fault history stored in a non-volatile memory accessible locally on the device without the use of communications
- l. The OLR relay shall have a minimum of a 10-fault history stored in a non-volatile memory accessible remotely through the use of communications/industrial network
- m. The OLR shall announce the following conditions and allow for configuration within the ranges listed:
  - 1) Motor Protection consisting of:
    - a) Thermal overload (FLAs 1-90 without external CTs, up to 540 amps with external CTs)
    - b) Jam, Stall and Current Level Alarming (Settable from 50-400% of FLA, or OFF)
    - c) Current unbalance (Settable from 1-30%, or OFF)
    - d) Current phase loss (60% fixed, or OFF)
    - e) Ground fault (Settable as low as 3 amps to 0.15 amps dependent on the number of wire passes through the current transformers, or OFF)
    - f) Phase rotation/reversal (Settable as OFF, ACB, ABC)
  - 2) Load protection consisting of:
    - a) Under-current (settable from 1-30%)
    - b) Low power (kW) (configurable based on range of device)
    - c) High power (kW) (configurable based on range of device)
  - 3) Line Protection consisting of:
    - a) Over-voltage (settable to 10% above OLR rated voltage)
    - b) Under-voltage (settable to 15% below OLR rated voltage)
    - c) Voltage phase unbalance (settable from 1-30%)
    - d) All Line Protection and Ground Fault shall be settable to alarm only mode or trip mode
  - 4) Protection Trip Delays
    - a) All Motor Protection shall have programmable trip delays by specific trip type from 1-20 seconds
    - b) All Load Protection shall have programmable trip delays by specific trip type from 1-60 seconds
    - c) All Line Protection shall have programmable trip delays by specific trip type from 1-20 seconds
- n. The OLR shall have the following local advanced monitoring capabilities not requiring communications:
  - 1) Current—Average and per phase RMS
  - 2) Voltage—Average and per phase RMS
  - 3) Power—Motor kW
  - 4) Power Factor

- 5) Frequency
  - 6) Thermal capacity
  - 7) Motor run hours
  - 8) Ground fault current
  - 9) Current unbalance %
  - 10) Voltage unbalance %
- o. The OLR shall have the following additional monitoring capabilities when using one of its industrial networks/communication modules
- 1) Time to restart after a line type fault
  - 2) Time to restart after a motor type fault
  - 3) Time to restart after a load type fault
  - 4) Motor Start Count
  - 5) Overload Relay Status
  - 6) Error Status
  - 7) Trip Reason
- p. The OLR shall have the ability to perform auto resets based on programmable timers
- 1) The OLR shall have a programmable auto reset for all Motor Type Faults, settable from 2-500 minutes
  - 2) The OLR shall have a programmable auto reset for Thermal Overload only, settable from 2-500 minutes
  - 3) The OLR shall have a programmable auto reset for Load Type Faults, settable from 2-500 minutes
  - 4) The OLR shall have the ability to auto reset for Line Type Faults.
  - 5) The OLR shall have the ability to limit the number of auto reset attempts to a number set by the user for Motor Type Faults, and a separate number set for Load Type Faults, after which a manual reset is required.
  - 6) The OLR shall have a programmable restart delay from 1-500 seconds after a power loss has occurred to ensure a deliberate start of multiple loads in a stepped fashion.
  - 7) The OLR shall have the ability to perform in slow starting high inertia loads, or where a reduced voltage soft starter is being used.
  - 8) The OLR shall have a settable transition time where protection can be disabled during a start time from 1-180 seconds to accommodate slow starting loads to prevent nuisance tripping.
  - 9) The OLR shall have a definable run current that can be used concurrently with the programmable transition time to ensure a successful start and then enabling all protection.
  - 10) The OLR shall have a dedicated remote-mounted display/operator-interface option (C4411) for use with enclosed control or motor control centers Type 12 remote display.
  - 11) The remote display shall be powered from the base unit with no need for control power or a power supply.

- 12) The base unit shall be able to communicate to the remote display and use one of the industrial protocols concurrently.
- 13) The remote display shall allow for configuration, monitoring, diagnostics, and control
- 14) The OLR shall have an optional remote-mounted HMI capable of configuration, monitoring, diagnostics, and control of numerous Motor Insight overload relays.
- 15) The HMI shall be NEMA 4X rated
- 16) The OLR shall be equipped with the following optional communication module\* Ethernet IP with I/O.
  - a) All option communication modules capable of 120 VAC or 24 VDC isolated inputs and form A B300 5 amp rated output relays.
  - b) All option communication modules with I/O must have 4 discrete inputs, and 2 discrete outputs.
  - c) Must work with Power Xpert Gateway and Power Xpert Software

4. NEMA Size 1 through 2 starters shall be suitable for the addition of at least six (6) external auxiliary contacts of any arrangement normally open or normally closed. Size 3 through 8 starters shall be suitable for the addition of up to eight (8) external auxiliary contacts of any arrangement normally open or normally closed

a. Motor starters shall be Allen-Bradley Centerline, Eaton FREEDOM Series or approved equal

C. Each starter shall be equipped with a fused control power transformer, two (2) indicating lights, Hand-Off-Auto (HOA) selector switch, and two (2) normally open contacts, unless otherwise scheduled on the drawings. A unit-mounted device panel shall have space to accommodate six (6) 30 mm oil-tight pilot-control devices or indicating ammeters, voltmeters, or elapsed time meters. In order to improve maintenance capabilities, the device panel shall withdraw with the unit. Door-mounted pilot devices are not acceptable.

D. Solid-state reduced-voltage starters, Eaton type S811 shall be provided where shown on the contract drawings. The solid-state reduced-voltage starter shall be UL and CSA listed in the motor control center, and consist of an SCR-based power section, logic board and paralleling bypass contactor. The paralleling bypass contactor shall be energized when the motor reaches full speed. Each solid-state reduced voltage starter shall have an addressable communication card capable of transmitting control and diagnostic data over an open network to either a personal computer or Logic Controller via network translator to DeviceNet, MODBUS 485, MODBUS/TCP / ETHERNET/IP, or PROFIBUS DP

E. Motor controllers shall be of the VFDs as shown on one-line diagrams, as specified Section 16330 and as specified in other applicable Sections of the specifications.

**2.07 Miscellaneous devices**

A. Overcurrent Devices

1. Circuit Breakers

a. Individual feeder breakers shall have a minimum interrupting capacity of \*65 kAIC at rated voltage or as scheduled on the drawings

B. Power Meter

- 1. The power meter shall be an Allen-Bradley PowerMonitor 500, model 1420-V2P-ENT
- 2. The meter shall support a power supply of 600 Volts AC

- a) Line-Neutral 160 to 480V; Line-Line 277 to 830V
- 3. The meter shall be UL listed and CE marked.
- 4. The meter shall be designed for Multifunction Electrical Measurement on 3 phase power systems. The meter shall perform to spec in harsh electrical applications in high and low voltage power systems.
  - a. The meter shall support 3-Element Wye, 2.5 Element Wye, 2 Element Delta, 4 wire Delta systems.
  - b. The meter shall accept universal voltage input.
  - c. The meter's surge withstand shall conform to IEEE C37.90.1.
  - d. The meter shall be user programmable for voltage range to any PT ratio.
- 5. The meter shall be a traceable revenue meter, which shall contain a utility grade test pulse allowing power providers to verify and confirm that the meter is performing to its rated accuracy.
- 6. The Option Cards shall provide the following features:
  - 1) 2 Relay outputs
  - 2) EtherNET/IP Communication
- 7. The meter shall have transformer loss, line loss, and total substation loss compensation.
  - a. Substation losses shall be programmable for Watts and VARs, and for Ferris and Copper losses.
  - b. The meter shall have CT and PT compensation to set compensation factors for errors in CTs and PTs connected to the meter.
- 8. Power meter shall be able to be stored in (-20 to +70) degrees C.
  - a. Operating temperature shall be (-20 to +70) degrees C.
  - b. The front of the power meter shall provide IP65, NEMA 4X and NEMA 12 protection degree.

## **2.08 Enclosures**

- 1. The type of enclosure shall be in accordance with NEMA standards for type 12 dust-tight and drip-proof. All enclosing sheet steel, wireways and unit doors shall be gasketed.

## **2.09 Identification**

- A. Each unit will have a 1.0 x 2.5-inch engraved nameplate. The lettering shall be 3/16-inch high, black on a white background.
- B. An engraved, plastic nameplate with white letters on black background shall be provided for each compartment. The nameplate shall indicate equipment controlled, as shown on the single-line diagram the nameplates shall be 1-inch by 3-1/8- inches and shall be mechanically fastened to the compartment door.
- C. All component and control identification nameplates shall be engraved with the device name and number exactly as it appears on the drawings, in the nameplate schedule. For devices not shown on the single line drawing such as time delay relays, the names will be as shown on the Control Schematic Drawings or as assigned by the Engineer.
- D. All control wires will be coded with the identification number as shown on the Control Schematic Drawings. Coding will be typed on a heat shrinkable tube applied to each end of the wire. The

marking shall be a permanent non-smearing solvent resistant type similar to Raychem TMS, Ideal Industries 3M Co., or equal

## 2.10 Finish

- A. The control center shall be given a phosphatizing pretreatment. The paint coating shall be a polyester urethane, thermosetting powder paint. Manufacturer's standard color shall be used. All structural steel and panels will be painted.
- B. The control center finish shall pass 600 hours of corrosion-resistance testing per ASTM B 117

## 2.11 Harmonic Correction Unit

- A. Shall be provided if the VFDs are not 18 Pulse VFDs.
- B. Where shown on the drawings, the motor control center shall include an integral harmonic correction unit for the attenuation of harmonics induced by nonlinear loads such as AC Adjustable Frequency Drives.
- C. The harmonic correction unit shall be in a totally enclosed deadfront, free-standing MCC assembly. Structures shall be 90 inches high and 20 inches deep for front-mounted units. Structures shall contain a horizontal wireway at the top, isolated from the horizontal bus and shall be readily accessible through a hinged cover.
- D. An operating mechanism shall be mounted on the primary of each harmonic correction unit. It shall be mechanically interlocked with the door to prevent access unless the disconnect is in the OFF position. A defeater shall be provided to bypass this interlock. With the door open, an interlock shall be provided to prevent inadvertent closing of the disconnect. Padlocking facilities shall be provided to positively lock the disconnect in the OFF position with from one (1) to three (3) padlocks with the door open or closed.
- E. Harmonic Correction Units shall be disconnected from the power source by a molded case switch. All units shall include 200,000 AIC rated fuses with Class T actuation. All units shall be provided with a grounding lug. Grounding by the contractor shall be performed according to local and national standards.
- F. The harmonic correction units shall be sized to meet 5% total harmonic current distortion {THD (I)}, 5% total demand distortion {TDD}, and <5% total harmonic voltage distortion {THD (V)} levels at incoming line terminals of the motor control center.
- G. The harmonic correction unit shall be designed in accordance with the applicable sections of the following standards. Where a conflict arises between these standards and this specification, this specification shall govern.
  - 1. ANSI IEEE standard C62.41-1991 [Surge Withstand Capacity]
  - 2. CSA 22.2, No. 14 & 66 [CSA requirements for power electronics]
  - 3. FCC Part 15, Sub Part J, Class A [RFI/EMI emission standards]
  - 4. ANSI IEEE standard 519-1992 [Harmonic limits]
  - 5. UL 508C [UL requirements for power conversion equipment]
  - 6. ICBO Building Code, Section 16, Seismic Zone 4 [Vibration Standard]
- H. The harmonic correction unit shall be installed in the motor control center by the motor control center manufacturer. The harmonic correction unit shall be approved by UL or CSA for installation in the motor control center.
- I. Modes of Operation

1. The harmonic correction unit shall be designed to electronically inject harmonic current to cancel load produced harmonic current such that the upstream power harmonic current and voltage are reduced to below 5% TDD and 5% THD (V) as defined by ANSI IEEE standard 519-1992 for load demand and voltage distortion limits. TDD as used herein refers to the total load demand of the applied circuit.
2. Reactive current compensation (a.k.a. displacement power factor correction) shall be activated via a digital keypad/display mounted on the door of the enclosure. When reactive current compensation is activated, the harmonic correction unit shall first perform harmonic current correction and then use the remaining capacity to inject reactive current compensation to the specified level herein defined.

#### J. Design

1. All harmonic correction units shall consist of power semiconductors that switch into the AC lines to modulate its output to cancel detrimental harmonic and/or reactive currents.
2. Each unit shall be designed with a current limiting function to protect the semiconductors. When this level is attained, a message shall be displayed indicating the output capacity is at-maximum capacity and actuate the at-maximum capacity relay. Operation shall continue indefinitely at this level without trip off or destruction of the power correction unit.
3. Two distinct levels of faults shall be employed. Non-critical level faults will provide automatic restart and a return to normal operation upon automatic fault clearance. Critical level faults stop the function of the unit and await operator action.
  - a. Faults such as AC line overvoltage, AC line undervoltage, AC line power loss, and AC line phase imbalance are defined as non-critical level faults.
  - b. All other types of faults shall be considered critical and stop the power correction system.

- K. The logic of the harmonic correction unit shall monitor the load current by utilizing two (2) current transformers (CTs) mounted on phases A and B to direct the function of the power electronic converter. A third current transformer is required if single- or three- phase line-to-neutral connected loads are present downstream from the location of the CTs.

#### L. Performance Requirements

1. Input Power
  - a. Voltage: 480V, 3-phase, 3-wire, plus ground.
  - b. Voltage Tolerance: +/- 10% of nominal
  - c. Frequency: 60 Hz, +/- 5%
  - d. Current Limit: 100% of rating
  - e. Surge Withstand Capability: ANSI/IEEE std C62.41-1991 without damage
  - f. Input Fuses: Rated at 200,000 AIC (amperes interrupting capacity), Class J

- M. Performance of the harmonic correction unit shall be independent of the impedance of the power source. All performance levels shall be attained whether on the AC lines or backup generator or output of the uninterruptible power supply (UPS).

#### N. Harmonic Correction

1. Limit 2nd through 50th order harmonic current to <5% TDD as defined in ANSI/IEEE STD 519-1992 at each installed location. Harmonic levels for individual harmonic orders shall comply with respective levels established in ANSI/IEEE STD 519-1992.

2. Limit the THD (V) added to the electrical system immediately upstream of the power correction system location(s) to less than or equal to 5% as defined in ANSI/IEEE STD 519-1992. The power correction system shall not correct for utility supplied voltage distortion levels.
3. Reactive Current Compensation: To .90 lagging displacement power factors. Leading power factor is not permitted.

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. Submit seismic calculations and installation details prior to installation.

### **3.02 Installation**

- A. Motor control centers shall be mounted on channel iron sills embedded in the concrete pads. Sills shall be accurately leveled to ensure that the panel structure will not be distorted.
- B. Field installed interior wiring shall be neatly grouped by circuit and bound by plastic tie wraps.
- C. All motor control centers shall be mounted to angle iron channels securely attached to the floor. Motor Control Centers shall meet seismic requirements by anchoring to floors and walls to prevent overturning. Submit calculations and installation details for approval including weight and dimensions of all motor control centers. The sections shall be set plumb and true with all sections at the same height.
- D. In general, all conduit entering or leaving a MCC shall be stubbed into the bottom horizontal wireway directly below the vertical wireway.

### **3.03 Field Quality Control**

- A. Provide the services of a qualified factory-trained manufacturer's representative to perform startup of the equipment specified under this section for a period of 5 working days.
- B. The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative:
  1. Rig the MCC assembly into final location and install on level surface
  2. Check all removable cells and starter units for easy removal and insertion
  3. Perform insulation tests on each phase and verify low-resistance ground connection on ground bus
- C. The Contractor shall provide three (3) copies of the manufacturer's field startup report
- D. Tests and Checks
  1. The following minimum test and checks shall be made twice: (1) Before energizing the motor control centers, and (2) six months after acceptance by owners:
    - a. Megger terminals and buses for grounds after disconnecting devices sensitive to meter voltage.
    - b. Remove all current transformer shunts after completing secondary circuit.
    - c. Install overload relay heaters based on actual motor nameplate current. If capacitors are installed between starter and motor, use overload relay heaters based on measured motor current.
    - d. Check all mechanical interlocks for proper operation.

### **3.04 Training**

- A. The Contractor shall provide a training session for up to five (5) owner's representatives for 2 normal workdays at the job site or other office location chosen by the owner.
- B. A manufacturer's qualified representative shall conduct the training session.
- C. The training program shall consist of the following:
  - 1. Review of the MCC one-line drawings and schedules
  - 2. Review of the factory record shop drawings and placement of the various cells
  - 3. Review of each type of starter cell, components within, control, and power wiring
  - 4. Review contactor coil replacement and contact replacement procedures
  - 5. Discuss the maintenance timetable and procedures to be followed in an ongoing maintenance program
  - 6. Provide three-ring binders to participants complete with copies of drawings and other course material covered

### **3.05 Examination**

- A. Contractor shall fully inspect shipments for damage and report damage to manufacturer and file claim upon shipper, if necessary.
- B. Contractor shall supply overload relay heater ratings that are properly sized and coordinated for each motor starter unit.

### **3.06 Installation**

- A. Contractor shall follow the installation instructions supplied by the manufacturer.
- B. Control wiring shall be as shown on the contract drawings except as modified by the approval and submittal process. Interface all local and remote devices into the control wiring and operational systems for each load.

### **3.07 Field Adjustments**

- A. The Contractor shall perform field adjustments of the short circuit and overload devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study, protective device coordination study, manufacturer's instruction leaflets, and the contract documents

### **3.08 Field Testing**

- A. Contractor is responsible for generation of a field report on tests performed, test values experienced, etc., and make the report available to owner upon request

### **3.09 Adjusting / Cleaning / Protection**

- A. Vacuum clean all interior equipment.

**\*\*END OF SECTION\*\***

## SECTION 16261 AUTOMATIC TRANSFER SWITCH

### PART 1 - GENERAL

#### 1.01 Summary

- A. Scope: Furnish and install automatic transfer switches (ATS) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the contract drawings. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.
- B. Automatic transfer switch shall be supplied as an "open unit" and shipped to the integrators fabrication, manufacturing facility for subsequent installation by the integrator into the main switchboard.

#### 1.02 References

- A. The automatic transfer switches and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of UL and NEMA as follows:

<u>Reference</u>	<u>Title</u>
UL 508	Industrial Control Equipment
UL 1008	Transfer Switches
UL 991	Test for Safety-Related Controls Employing Solid State Devices
NFPA 70	National Electrical Code
NFPA 99	Essential Electrical Systems of Health Care Facilities
NFPA 110	Emergency and Standby Power Systems
NEMA ICS 10	AC Transfer Switch Equipment
IEEE 446	Recommended Practice for Emergency and Standby Power Systems
IEC 947-6-1	Low-voltage Switchgear and Controlgear; Multifunction equipment; Automatic Transfer Switching Equipment
IEC 60801-2	Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment, Electrostatic Discharge Requirements
IEC 60801-3	Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment, Radiated Electromagnetic Field Requirements
IEC 60801-4	Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment, Electrical Fast Transient/Burst Requirements
IEC 60801-5	Electromagnetic Compatibility for Electrical and Electronic Equipment, Surge Immunity Requirements
CISPR 11	Industrial, Scientific, and Medical Radio-Frequency Equipment – Electromagnetic Disturbance Characteristics – Limits and Methods of Measurement

## Reference

## Title

Compliant with FCC Part 15, Subpart B, Class A

### **1.03 Submittals**

- A. The Submittals shall comply with the provisions set forth in Sections 01300 and 16010.
- B. The following information shall be submitted to the Engineer:
  - 1. Front view and plan view of the assembly
  - 2. Schematic diagram
  - 3. Conduit space locations within the assembly
  - 4. Assembly ratings including:
    - a. Withstand and Closing rating
    - b. Voltage
    - c. Continuous current rating
    - d. Short-Time rating if applicable
    - e. Short-circuit rating if ordered with integral protection
  - 5. Cable terminal sizes
  - 6. Product Data Sheets
  - 7. Wiring diagrams
  - 8. Certified production test reports
  - 9. Installation information
  - 10. Seismic certification as specified.

### **1.04 Quality Assurance**

- A. Qualifications
  - 1. The manufacturer of the assembly shall be the manufacturer of major components and control modules installed within the assembly.
  - 2. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
  - 3. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of Uniform Building Code (UBC) for zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, UBC: a peak of 2.15g's (3.2–11 Hz), and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
  - 4. The manufacturer of the ATS shall also have a national service organization that is available throughout the contiguous United States and is available on call 24 hours a day, 365 days a year.

5. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years

#### B. Manufacturer's Certification

1. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
2. The Contractor shall provide three (3) copies of the manufacturer's representative's certification.

#### C. Withstand and Closing Ratings

1. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of overcurrent protection shown on the plans.
2. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable

#### D. Tests and Certification

1. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
2. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.
3. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001

### **1.05 Delivery, Storage, and Handling**

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment
- B. Refer to Section 16010, 1.07 for additional requirements

### **1.06 Project / Site Conditions**

- A. The automatic transfer switches will be installed in water facilities where the ambient temperatures are expected to range between 10 degrees F and 115 degrees F. Relative humidity is expected to range from 10 percent to 100 percent.

### **1.07 Warranty**

- A. Refer to Section 17506 for requirements

### **1.08 Maintenance**

- A. Refer to Section 17506 for requirements.

- B. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Automatic transfer switch shall be sourced from same manufacturer as the generator (Kohler, no equal) as follows:

1. Kohler Model KCS-DMTG-0800S with Decision Maker MPAC 1500 Automatic Controller.

### **2.02 Equipment and Materials**

#### **A. General**

1. The transfer switch shall be rated for the voltage and ampacity as shown on the plans and shall have 600 volt insulation on all parts in accordance with NEMA standards
2. The current rating shall be a continuous rating when the switch is installed in an unventilated enclosure, and shall conform to NEMA temperature rise standards
3. The unit shall be rated based on all classes of loads, i.e., resistive, tungsten, ballast and inductive loads. Switches rated 400 amperes or less shall be UL listed for 100% tungsten lamp load.
4. As a precondition for approval, all transfer switches complete with accessories shall be listed by Underwriters Laboratories, under Standard UL 1008 (automatic transfer switches) and approved for use on emergency systems
5. The withstand current capacity of the main contacts shall not be less than 20 times the continuous duty rating when coordinated with any molded case circuit breaker established by certified test data. Refer to required withstand and close ratings as detailed in this specification.
6. Temperature rise tests in accordance with UL 1008 shall have been conducted after the overload and endurance tests to confirm the ability of the units to carry their rated currents within the allowable temperature limits.
7. Transfer switches shall comply with the applicable standards of UL, cUL, CSA, ANSI, NFPA, IEEE, NEMA.
8. The transfer switches shall be supplied with a microprocessor based control panel as detailed further in these specifications

#### **B. Sequence of Operation**

1. The ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the normal source.
2. When the voltage of any phase of the normal source is reduced to 80% or exceeds 110% nominal voltage, or frequency is displaced 2 Hz from nominal, for a period of 0-10 seconds (programmable) a pilot contact shall close to initiate starting of the engine generator.
3. The ATS shall incorporate adjustable three phase under and over-voltage and three phase under and over-frequency sensing on the emergency source.
4. When the emergency source has reached a voltage value within +/- 10% of nominal and achieved frequency within +/- 5% of the rated value, the load shall be transferred to the emergency source after a programmable time delay.

5. When the normal source has been restored to not less than 90% of rated voltage on all phases, the load shall be re-transferred to the normal source after a time delay of 0 to 30 minutes (programmable). The generator shall run unloaded for 5 minutes (programmable) and then automatically shut down. The generator shall be ready for automatic operation upon the next failure of the normal source.
6. If the engine generator should fail while carrying the load, retransfer to the normal source shall be made instantaneously upon restoration of proper voltage (90%) on the normal source.
7. Inspection and operational tests shall be conducted by the contractor in the presence of the engineer, to indicate that the switch satisfies the specifications.
8. The transfer switch shall be equipped with a microprocessor based control panel. The control panel shall perform the operational and display functions of the transfer switch. The display functions of the control panel shall include ATS position and source availability
9. The digital display shall be accessible without opening the enclosure door and shall be provided with a 4 line by 20 character LCD display screen with touch pad function and display menus. The programming functions shall be pass code protected.
10. The control panel shall be provided with menu driven display screens for transfer switch monitoring, control and field changeable functions and settings.
11. The control panel shall be opto-isolated from electrical noise and provided with the following inherent control functions and capabilities:
  - a. Multipurpose display for continuous monitoring and control of the ATS functions and settings. All field changeable functions shall be pass code protected and accessible through the keypad.
  - b. Built-in diagnostic display that includes the capturing of historical data, such as number of transfers and time on emergency power source, for ease of troubleshooting.
  - c. Capability for external communication and network interface.
  - d. Touch pad test switch with Fast Test/Load/No Load positions to simulate a normal source failure.
  - e. Time delay to override momentary normal source failure prior to engine start. Field programmable 0-10 seconds (adjustable by increments of 0.1 second) factory set at 3 seconds.
  - f. Time delay on retransfer to normal source, programmable 0-60 minutes (adjustable by increments of 0.1 minute) factory set at 30 minutes. If the emergency source fails during the retransfer time delay, the transfer switch controls shall automatically bypass the time delay and immediately retransfer to the normal position.
  - g. Time delay on transfer to emergency, programmable 0-5 minutes, factory set at 1 second.
  - h. Time delay on transfer in either direction in the center-off position, programmable 0-2 minutes, factory set at 5 seconds.
  - i. Terminals for remote test/peak shave operation and transfer inhibit to the emergency source.
  - j. Auxiliary contacts (1 N.O.) shall be provided to indicate normal and emergency source availability.
  - k. A load/no load clock exerciser shall be incorporated within the microprocessor and shall be programmable to start the engine generator set and transfer the load (when selected) for exercise purposes on a weekly basis. The exerciser shall contain a lithium battery for memory retention during an outage.

- l. A timed auxiliary contact (1 N.C.) adjustable 0-60 seconds shall be provided to allow motor loads to be disconnected prior to transfer in either direction.
- m. Provide a momentary pushbutton to bypass the time delays on transfer and retransfer and programmable commit/no commit control logic.
- n. The following option features shall be provided:
  - 1) Meter – Ammeter: Three phase with phase selector switch
  - 2) Meter – Voltmeter: Three phase with phase selector switch
  - 3) Extended Time Delay - Engine Start: Adjustable 0.5 to 300 seconds
  - 4) Selector Switch: Three-position switch – Stop/Test/Automatic

C. Construction and Performance

1. The automatic transfer switch shall be a double throw switch operated by a reliable dual electrical mechanism momentarily energized.
2. The transfer switch shall incorporate a timed, center-off position for motor load decay. Transfer time shall be adjustable from 0-10 seconds. A mechanical interlock shall be provided to ensure that both sets of contacts cannot be closed at the same time.
3. For switches installed in systems having ground fault protective devices, and/or wired so as to be designated a separately derived system by the NEC, a 4th pole shall be provided. This additional pole shall isolate the normal and emergency neutrals. The neutral pole shall have the same withstand and operational ratings as the other poles and shall be arranged to break last and make first to minimize neutral switching transients. Add-on or accessory poles that are not of identical construction and withstand capability are not acceptable.
4. The contact structure shall consist of a main current carrying contact which is a silver alloy with a minimum of 50% silver content. The current carrying contacts shall be protected by silver tungsten arcing contacts on all sizes above 400 Amps.
5. The transfer switch manufacturer shall submit test data for each size switch, showing it can withstand fault currents of the magnitude and the duration necessary to maintain the system integrity. Minimum UL listed withstand and close into fault ratings shall be as follows:

<u>Size (Amps)</u>	<u>Any Molded Case Breaker* (RMS Symmetrical)</u>
Up to 100	22,000
101 - 260	30,000
261 - 400	35,000
401 - 1200	50,000
1201 - 4000	100,000

<u>Size (Amps)</u>	<u>Specific Coordinated Molded Case Breaker</u>
Up to 100	22,000
101 - 260	42,000
261 - 400	50,000
401 - 800	65,000
801 - 1200	85,000
1201 - 4000	100,000

<u>Size (Amps)</u>	<u>Current Limiting Fuse</u>
Up to 4000	200,000

\*All values 480 volt, RMS symmetrical, less than 20% power factor.

6. A dielectric test at the conclusion of the withstand and closing tests shall be performed.
7. The automatic transfer switch manufacturer shall certify sufficient arc interrupting capabilities for 50 cycles of operation between a normal and emergency source that are 120 degrees out of phase at 480 volts, 600% of rated current at .50 power factor. This certification is to ensure that there will be no current flow between the two isolated sources during switching.
8. All relays shall be continuous duty industrial type with wiping contacts. Customer interface contacts shall be rated 10 amperes minimum. Coils, relays, timers and accessories shall be readily front accessible. The control panel and power section shall be interconnected with a harness and keyed disconnect plugs for maintenance.
9. Main and arcing contacts shall be visible without major disassembly to facilitate inspection and maintenance.
10. A manual handle shall be provided for maintenance purposes with the switch de-energized. An operator disconnect switch shall be provided to defeat automatic operation during maintenance, inspection or manual operation.
11. The switch shall be mounted in a NEMA 1 enclosure unless otherwise indicated on the plans.
12. Switches composed of molded case breakers, contactors or components thereof not specifically designed as an automatic transfer switch will not be acceptable.
13. The automatic transfer switch must be equipped with a solenoid protection scheme that removes any attempts of operating the solenoids after (3) consecutive trials until manual intervention by an operator

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- B. All necessary hardware to secure the assembly in place shall be provided by the Contractor.
- C. The equipment shall be installed and checked in accordance with the manufacturer's recommendations.

### **3.02 Field Quality Control**

- A. Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of two working days. The manufacturer's representative shall provide technical direction and assistance to the contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
- B. The Contractor shall provide three (3) copies of the manufacturer's field start-up.
- C. Performance Tests
  1. Field test and calibrate timing and monitoring logic. All adjustment shall be within 5% of the previously specified set points.

2. Field test the transferring of loads between normal and emergency power sources as follows:
  - a. Start loads located downstream of the ATS.
  - b. De-energize the normal power source. Verify that the standby generator starts and the load is transferred to the standby source.
  - c. Energize the normal source. Verify that after the selected time delay, the load is transferred to the normal power source. Verify that after the load is switched the generator continues to operate unloaded for the time specified. At the end of the period verify that the generator shuts off.
3. Field test and calibrate the in-phase monitor. Demonstrate that the switch transfers when source phase differences are within 20 degrees under varying generator speeds.
4. Notify the Owner in writing 48 hours in advance of testing for witness by County Inspector.

### **3.03 Adjusting / Cleaning / Protection**

#### **A. Training**

1. The contractor shall provide a training session for up to five (5) owner's representatives for two normal workdays at a jobsite location determined by the owner.
2. The training session shall be conducted by a manufacturer's qualified representative. The training program shall consist of the instruction on the operation of the assembly, circuit breakers and major components within the assembly

**\*\*END OF SECTION\*\***

## SECTION 16300 ELECTRICAL SERVICE EQUIPMENT

### PART 1 - GENERAL

#### 1.01 Summary

- A. The Contractor shall furnish and install the main service equipment, Main Switchboard 'MSB' as specified herein and as shown on the contract drawings.
- B. This section provides specifications for all service related equipment required to accept electrical power from the utility company.
- C. Type: The Main Service Equipment shall be free standing, outdoor type as noted on drawings. It shall have an incoming pull section, metering section, service disconnect, etc. all in accordance with Owner's requirements.

#### 1.02 References

- A. All equipment and installation procedures shall be in accordance with the latest applicable standards, codes, and practices of NEMA and ANSI and shall, where applicable, conform to regulations of UL, ASA, IEEE, NEC and other applicable standards.
- B. The low voltage metering switchboard shall be UL labeled.

<u>Reference</u>	<u>Title</u>
IEEE C37.13	Standard For Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.16	Switchgear - Low Voltage Power Circuit Breakers and AC Power Circuit Protectors – Preferred Ratings, Related Requirements, and Application Recommendations
IEEE C37.20.1	Metal-Clad Low Voltage Power Circuit Breakers Used in Enclosures
IEEE C37.20.3	Metal Enclosed Interrupter Switchgear
IEEE C37.50	Switchgear – Low Voltage AC Power Circuit Breakers Used in Enclosures – Test Procedures
IEEE C37.100	Standard Definitions for Power Switchgear, Supplement C37.100B
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NFPA 70	National Electrical Code
UL 489	Standard for Safety Molded-Case Circuit Breakers and Circuit Breaker Enclosures
UL 1025	Standard for Safety Electric Air Heaters
UL 1558	Standard for Safety Metal-Enclosed, Low-Voltage Power Circuit Breaker Switchgear

#### 1.03 Submittals

- A. Scope: Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

#### 1.04 Quality Assurance

- A. Performance and Design Requirements

1. General:

a. The equipment furnished under this section shall provide the required protection for a system distributing continuous 24-hour per day, 7-day per week operation. The Main Service Equipment for the combination meter and main circuit breaker shall be 100% rated, 480-volt, 3-phase, 4-wire 60Hz AC. The AIC ratings shall be 65,000A. The bus bracing shall be as noted on the drawings.

2. Power Distribution System:

a. Electric power will be supplied to the service equipment from a new utility transformer located adjacent to the project site.

b. The power distribution system shall be a completely integrated assembly for automatic unattended operation and distribution of power.

B. Qualifications

1. The Contractor shall cause service equipment to be furnished by a same system integrator of the motor control centers who shall be regularly engaged in the design, procurement, installation, start-up and maintenance of such a system. A statement setting forth the manufacturer's experience, knowledge, and the ability of personnel available for the work shall be submitted to the Engineer.

2. These requirements shall not be construed as relieving the Contractor of its responsibility for this portion of the work. It is the intent of these Specifications that the system integrator, furnish satisfactory evidence that it has the requisite experience and ability and that it has the facilities and prior proven experience in such systems.

3. The system integrator shall also provide complete documentation of its service facilities. The service facilities shall be located within 150 miles of the project location.

4. Service Equipment Components: All circuit breakers manufactured by Eaton, Schneider Electric, General Electric or equal.

5. Main Switchboard shall be built in strict accordance with the overall sizing and component layouts as detailed on the Drawings and no deviations will be allowed without prior approval of the Engineer.

a. Note that the overall length of the Main Switchboard shall not exceed the overall length of the Main Switchboard as shown on the contract drawings.

b. If submitted Main Switchboard manufacturer is an "or equal" and cannot meet the overall length of the Main Switchboard elevation shown on the contract drawings, the contractor shall provide one of the two named manufacturers

6. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

7. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of Uniform Building Code (UBC) for Zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, UBC: a peak of 2.15g's (3.2 – 11 Hz), and a ZPA of 0.86g's applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.

8. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.

- a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
- b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
- c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

### **1.05 Delivery, Storage, and Handling**

- A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location agreeable with the Engineer, secure from weather or accidental damage.
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- C. Refer to Section 16010, 1.07 for additional requirements

### **1.06 Project / Site Conditions**

- A. All materials used in connection with the electrical service will be installed outdoors in a water facility. Temperatures are expected to range from 10 degrees F and 115 degrees F. Relative humidity is expected to range from 10 percent to 100 percent.

### **1.07 Warranty**

- A. Refer to Section 17506 for requirements

### **1.08 Maintenance**

- A. Operation and Maintenance Manuals
  1. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.
- B. Standby Components
  1. The following standby components shall be provided:
  2. One complete set of special maintenance tools
- C. Refer to Section 17506 for additional requirements.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

1. Schneider Electric Square D
2. Eaton
3. General Electric

## **2.02 Equipment and Materials**

### **A. Ratings**

1. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of 65,000 amperes symmetrical at rated voltage.

### **B. Construction – Main Distribution Switchboards:**

1. Steel enclosures shall be a minimum of G-90 galvanized steel. All edges shall be smooth after forming. Enclosure shall be painted after fabrication. Finish coat shall be minimum of 2 mils thickness and provide a tough, non-chalking weather resistant finish. Construction shall be in accordance with ANSI/UL50. Enclosures shall be rated NEMA Type 1. Mounting bosses shall provide 0.125-inch minimum air space between back of the meter main/combinations and the mounting surface. Meter main/combinations sealing shall be provided by minimum 304 stainless steel latches and rivet with provision for 3/8-inch padlock and/or ribbon seal.
2. The entire assembly shall consist of a underground pull section, a service entrance rated transfer switch and distribution breakers where shown on plans.
3. The main section shall include:
  - a. A service rated main breaker and automatic transfer switch
  - b. Utility meter, Current transformers
  - c. Main lugs for use with conductor connection

### **C. Finish**

1. The finish shall consist of a coat of gray (ANSI-61), thermosetting, polyester powder paint applied electrostatically to pre-cleaned and phosphatized steel and aluminum for internal and external parts. The coating shall have corrosion resistance of 600 hours to 5% salt spray.

## **2.03 Components and Accessories**

### **A. Meter main/combination jaws:**

1. Block assemblies shall be replaceable from the front. Current carrying meter main/combinations jaws shall be reinforced and have meter blade guides. The jaws shall be tin plated, capable of carrying full rated (continuous) current and withstand the mechanical and heat rise requirements of ANSI/UL 414.

### **B. Bus**

1. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient (outside the enclosure).
2. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.
3. A copper ground bus (minimum ¼ x 2 inch), shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.
4. All hardware used on conductor shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers

#### C. Terminal Connectors:

1. Terminal connectors shall be suitable for use with aluminum and copper conductors. Connectors shall be tin plated and capable of carrying full rated (continuous) current and withstand the mechanical and heat rise requirements of ANSI/UL 486B.

#### D. Terminal Blocks

1. All connections shall be made at terminal blocks and shall comply with other portions of the specifications.

#### E. Circuit breakers

1. Circuit Breaker: Provide an Eaton Cutler-Hammer Series G L-Frame Electronic Trip Unit with Arcflash Reduction Maintenance System Molded Case Circuit Breaker. Circuit breaker shall be 100% rated and have a minimum rating not less than the KAIC rating indicated on single line diagrams in the contract documents. If no specific value for a specific bus is shown on the drawings, the contract shall supply devices rated for 65 KAIC symmetrical.
2. The trip unit shall be provided with an Arcflash Reduction Maintenance System Technology capability. The Arcflash Reduction Maintenance System shall allow the operator to enable a maintenance mode using a 5-position switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. A blue LED on the trip unit shall indicate the trip unit is in the maintenance mode.
3. The trip unit shall utilize ARMs Technology (Arc Flash Reduction Maintenance System). The ARMs Technology shall be provided in a system that shall reduce the trip unit Instantaneous pickup value when activated. The ARMs device shall not compromise breaker phase protection even when enabled. Once the ARMs unit is disabled, the recalibration of trip unit phase protection shall not be required. Activation and deactivation of the ARMs Technology trip setting shall be accomplished without opening the circuit breaker door and exposing operators to energized parts. The ARMs Technology shall provide a clearing time of 0.04 seconds, adjustable with a minimum of five settings ranging from 2.5X to 10X of the sensor value.
4. The ARMs Technology shall be provided with a inner door panel mounted enable padlockable selector switch and indication via Blue LED pilot light.
5. Submit short circuit calculations based upon Owner supplied information for approval.

- #### F. Utility Metering - Where shown on drawings, provide separate barriered-off utility metering compartment or structure complete with hinged sealable door. Bus work shall include provisions for mounting utility company current transformers and potential transformers as required by the utility company. Provide service entrance label and provide necessary applicable service entrance features per NEC and local code requirements. The Supplier shall obtain Utility approval of the line and metering sections PRIOR to construction of the gear.

#### G. Nameplates

1. Nameplates shall be provided for each compartment. Additionally, each device shall be identified by appropriate nameplates which indicate equipment controlled as shown.
2. Nameplates for switches, devices and circuit breakers shall be laminated phenolic plastic with black face and white core engraved through the outer layer.
3. Nameplates shall be secured to the front of the enclosure with self-tapping screws or machine bolts and nuts. Embossed pressure sensitive plastic tape labels shall not be used.
4. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Examine the area to receive the service equipment to assure adequate clearance for switchboard installation and workspace required by code (NEC Article 110).
- B. All equipment shall be located and installed to be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in location of equipment prior to roughing in without incurring any additional cost.
- C. Although the Drawings and Specifications have been prepared in compliance with regulations of PG&E, it shall be the responsibility of the Contractor to coordinate the arrangements with PG&E. The Contractor shall bear all costs associated with the electrical power installation as shown on the drawings. The District will pay all PG&E fees.
- D. The sections shall be securely bolted to wall to meet seismic requirements to prevent overturning, as noted in Section 11050, Equipment Mounting. Installation requirements shall be as recommended by service equipment manufacturer. Submit calculations and installation details for approval including weight and dimensions of all switchboards. The sections shall be set plumb and true with all sections at the same height.
- E. Submit seismic calculations prior to installation.

### **3.02 Field Quality Control**

- A. Operation and Maintenance Manuals
  - 1. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.
- B. Factory Testing
  - 1. General: The power distribution system shall be subjected to static and operational testing. The tests shall be conducted in accordance with IEEE standards and recommendations in addition to other applicable standards.
  - 2. Static Testing: The power distribution system as described above and including all accessories shall be set up and tested using the static method. All safety devices and control circuits shall be properly installed, adjusted, and connected. All interconnecting wiring shall be checked to ensure proper interconnection. Insulation tests shall be performed on the control circuits and the bus circuits.
  - 3. Operating Testing: The complete system shall be set up in a test cell and operated with simulated power sources and loads to determine the characteristics under load. Performance of various safety operating requirements as specified in this section and in other sections.
- C. Field Testing
  - 1. After completion of installation, static testing shall be performed which shall include visual inspection and verification of various functions.
  - 2. Power shall be applied to the main service equipment and the Contractor shall demonstrate the ability of the equipment to perform the required functions as specified. A manufacturer's qualified technical representative shall be present and assist the Contractor during testing. The Contractor shall demonstrate to the Engineer that the entire system operates as specified

**\*\*END OF SECTION\*\***

# SECTION 16310 PANELBOARDS

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This section provides specifications for all panelboards. Furnish and install panelboards as indicated on the panel schedule, in the drawings, and in this specification.
- B. Where panelboards are shown integrated into the MCC, the panelboards shall be supplied by the same manufacturer as the MCC and designed by the manufacturer for integration into the MCC sections.

### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
IEEE C62.1	Surge Arrestors for Alternating Current Power Circuits
IEEE C62.11	Standards for Metal-Oxide Surge Arrestors for AC Power Circuits
NECA 407	Recommended Practice for Installing and Maintaining Panelboards
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA 289	Application Guide for Ground Fault Circuit Interrupters
NEMA AB 1	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures
NEMA KS 1	Enclosed Switches
NEMA LA 1	Surge Arrestors
NEMA PB 1	Panelboards
NEMA PB 1.1	General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less
NFPA 70	National Electrical Code
UL 67	Standard for DISTPanelboards
UL 98	Standard for Enclosed and Dead-Front Switches
UL 486E	Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors
UL 489	Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures
UL 508	Standard for Industrial Control Equipment
UL 943	Standard for Ground-Fault Circuit Interrupters

### 1.03 Submittals

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

#### **1.04 Quality Assurance**

- A. Each panelboard shall comply with applicable standards of the Underwriter's Laboratories, Inc.

#### **1.05 Delivery, Storage, and Handling**

- A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location secure from weather or accidental damage.

#### **1.06 Project / Site Conditions**

- A. The panelboards shall be suitable for installation at the locations shown and as described under Section 16020 – General Electrical Provisions.
- B. PRODUCTS

#### **1.07 Manufacturers**

- A. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.
  - 1. Eaton
  - 2. Or Approved Equal

#### **1.08 Equipment and Materials**

- A. Service Conditions
  - 1. Mounting as indicated on plans.
- B. Ratings
  - 1. As shown on the drawings.
  - 2. Minimum short circuit rating: As required to meet the Short Circuit Study and Protective Device Evaluation and Coordination Study as specified in specification section 16011 but not less than 22,000 symmetrical rms Amperes.
- C. Construction
  - 1. Cabinets: Code gauge steel cabinets, dead front panels and doors. Fasten dead front panels to cabinets with concealed trim fasteners concealed front door hinges.
  - 2. Locks: Flush door locks, keyed alike for all panelboards.
- D. Finish
  - 1. All painted steel work shall be treated with a primer coat and finish coat of the manufacturer's standard gray color.

#### **1.09 Components and Accessories**

- A. Bussing
  - 1. Bussing shall be rectangular cross section copper.
  - 2. Each panelboard shall be equipped with a ground bus secured to the interior of the enclosure. The bus shall be equal to the panelboard neutral bus and shall have a separate lug for each ground conductor. Not more than one conductor shall be installed per lug.

## B. Circuit Breakers

1. Feeder breakers shall be Bolt-on type
2. Main breakers shall be rated for 65kAIC.
3. Manufacturer shall be the same as the panelboard or switchboard in which they are mounted.
4. Where two pole breakers occur in the panels, they shall be common trip units. Single pole breakers with tie-bar between handles will not be accepted.

C. Breakers shall have toggle, quick-make, and quick-break operating mechanisms with trip-free feature to prevent contacts being held closed against overcurrent conditions in the circuit. Trip position of the breakers shall be clearly indicated by movement of the operating handles to the center position.

## D. Nameplates and Directory

1. Each panel shall have a neatly typewritten directory with the name and number of the room or the equipment served by each circuit breaker which shall correspond with the final circuit arrangement. Spaces in directories for spare circuit breakers shall be neatly marked "Spare" in pencil. The directory shall also indicate the panel designation, voltage, and phase at the top. Each directory shall be mounted in metallic index cardholder behind a clear plastic window.

## **PART 2 - EXECUTION**

### **2.01 Installation**

A. All equipment shall be installed so that it is readily accessible for operation and maintenance.

### **2.02 Adjusting / Cleaning / Protection**

A. All circuits shall be tested and verified for correct connections.

**\*\*END OF SECTION\*\***

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## SECTION 16320 SURGE PROTECTIVE DEVICES

### PART 1 - GENERAL

#### 1.01 Summary

- A. Scope: The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers (MCC).

#### 1.02 References

- A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards:

<u>Reference</u>	<u>Title</u>
ANSI/IEEE C62.62	Test Specifications for Surge Protection Devices for Low Voltage AC Power Circuits
ANSI/IEEE C62.41	Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits
ANSI/IEEE C62.45	Recommended Practice on Surge Testing for Equipment Connected to Low Voltage (1000V and Less) AC Power Circuits
IEEE C62.43	Guide for the Application of Surge Protectors Used In Low –Voltage Data, Communications, and Signaling Circuits
IEEE C62.48	IEEE Guide on Interactions Between Power System Disturbances and Surge-Protective Devices
FIPS Pub 94	Guideline on Electrical Power for ADP Installations
NEMA LS-1	Low Voltage Surge Protective Devices
NFPA 70	National Electrical Code
NFPA 780	Standard for the Installation of Lightning Protection Equipment
UL 96A	Installation Requirements for Lightning Protection Systems
UL 1449	Surge Protective Devices
UL 1283	Electromagnetic Interference Filters

- B. International Standards Organization (ISO) Company certified ISO 9001 for manufacturing, design and service.
- C. The systems individual units shall be UL Listed and labeled under UL 1449 Standard for Surge Protective Devices (SPD) and the surge ratings shall be permanently affixed to the SPD. The units shall also be listed and labeled to UL1283 Standard for Electromagnetic Interference Filters, and CSA Listed.
- D. The specified system shall be thoroughly factory-tested before shipment. Testing of each system shall include but shall not be limited to quality control checks, "Hi-Pot" tests at two times rated

voltage plus 1000 volts per UL requirements, IEEE C62.41 Category B surge tests, UL ground leakage tests, and operational and calibration tests.

### **1.03 System Description**

#### **A. 480 Volt Connections**

1. These specifications are based on the Eaton's SPD Series or equal for use on the 480V power connection points indicated on the contract documents. Other manufacturers shall provide detailed compliance or exception statements to all provisions of this specification to allow consideration.

#### **B. 120/208 Volt Connections**

1. These specifications are based on the Eaton's SPD Series or equal for use on the 120/208 V power connection points indicated on the contract documents. Other manufacturers shall provide detailed compliance or exception statements to all provisions of this specification to allow consideration.

### **1.04 Submittals**

A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

#### **B. Documentation**

1. Equipment Manual: The manufacturer shall furnish an installation manual with installation, start-up, and operating instructions for the specified system.
2. Drawings: Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, component and connection locations, mounting provisions, connection details, and wiring diagram.
3. UL 1449 Ratings: Provide verification that the SPD complies with the required ANSI/UL 1449 4th Edition or later listing by Underwriters Laboratories (UL). Compliance may be in the form of a file number that can be verified on UL's website [www.ul.org](http://www.ul.org), the website should contain the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current  $I_n$ .
4. Spare Parts: A list of recommended spare parts shall be supplied at the customer's request

### **1.05 Quality Assurance**

A. The specified system shall be tested at the component and fully assembled level, under surge conditions with AC power applied for a minimum of 1 hour. Testing shall include but not be limited to quality control checks, dielectric voltage withstand test per UL and CSA requirements, UL ground continuity tests and operational and calibration tests.

1. The manufacturer of the electrical distribution equipment shall be the manufacturer of the SPD within the listed electrical distribution equipment.
2. For the equipment specified herein, the manufacturer shall be ISO 14001 and ISO 9001 or 9002 certified.
3. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
4. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU and have a visible label showing compliance.

5. The SPD shall be UL 1449 current edition listed, 20 kA  $I_n$  Type 1 or Type 2 for use in UL 96A systems

### **1.06 Delivery, Storage, and Handling**

- A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.
- B. Refer to Section 16010, 1.07 for additional requirements.

### **1.07 Project / Site Conditions**

- A. The SPD may be installed indoors in a water treatment facility as shown on the contract drawings or as specified herein. The ambient temperature may range from 10 degrees F and 115 degrees F. Relative humidity may range from 10 to 95 percent

### **1.08 Sequencing and Scheduling**

- A. Sequencing and scheduling plan shall be provided that minimizes wastewater facility downtime. Note that the wastewater facility must remain operational during all phases of construction. For additional requirements refer to Special Provisions.

### **1.09 Warranty**

- A. The manufacturer shall provide a ten (10) year warranty (15 year warranty with registration) that covers replacement of the complete unit, including lightning, from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code..

### **1.10 Maintenance**

- A. Refer to Section 17506 for requirements

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Eaton SPD Series, Liebert or approved equal.
  1. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

### **2.02 Voltage Surge Suppression – General**

- A. Electrical Requirements
  1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
  2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
  3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any

environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.

4. Unit shall operate without the need for an external overcurrent protection device (OCPD), and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.
5. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Configuration	Protection Modes			
	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

6. Nominal Discharge Current ( $I_n$ ) – All SPDs applied to the distribution system shall have a 20kA  $I_n$  rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an  $I_n$  less than 20kA shall be rejected.
7. ANSI/UL 1449 4<sup>th</sup> Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4<sup>th</sup> Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

## B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
  - a. Type 2 units with filtering shall conform to UL 1283 5<sup>th</sup> Edition

- b. Type 1 units shall not contain filtering or have a UL 1283 5<sup>th</sup> Edition Listing.
- 4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
- 5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring features:
  - a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
    - 1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
    - 2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
    - 3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
  - b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
  - c. Audible Alarm and Silence Button– The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
  - d. Surge Counter – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of  $50 \pm 20A$  occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
    - 1) The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
- 6. Thermal MOV Protection.
  - a. The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD’s components and diagnostics shall be contained within one discrete assembly. The use of plug in single-mode modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
8. Safety Requirements:
  - a. The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
  - b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

**2.03 System Application:**

- A. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
- B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table.

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

**2.04 Lighting and Distribution Panelboard Requirements:**

- A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments
  1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
  2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
  3. The panelboard shall be capable of re-energizing upon removal of the SPD.
  4. The SPD shall be integral to the panelboard and connected directly to the bus. Alternately, an integral SPD can be connected to a circuit breaker for disconnecting purposes, in the case a disconnect is required.

5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

## **2.05 Switchgear, Switchboard, MCC and Busway Requirements**

- A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
- B. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, or busway.
- C. The SPD shall be factory installed integral to the switchgear, switchboard, MCC, and/or bus plug at the assembly plant by the original equipment manufacturer.
- D. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
- E. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
- F. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
- G. All monitoring and diagnostic features shall be visible from the front of the equipment.

## **2.06 Service Entrance Requirements:**

- A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments.

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. The installation of the SPD shall be factory installed integral to the distribution equipment. The Contractor shall install all distribution equipment per the manufacturer's recommendations, applicable electrical codes and the contract drawings.
- B. 480 volt SPD units shall be provided for the Main Switchboard or in the Motor Control Center as noted on the contract drawings..
- C. 120/208 SPD units shall be provided at all new 120/208 circuit breaker panels that provide power to the new and existing control panels

**\*\*END OF SECTION\*\***

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# SECTION 16324 UNINTERRUPTIBLE POWER SUPPLY

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: These specifications describe requirements for an Uninterruptible Power System (UPS) consisting of one UPS unit per control panel. The UPS shall automatically maintain AC power within specified tolerances to the critical load, without interruption, during failure or deterioration of the normal power source.
- B. The manufacturer shall design and furnish all materials and equipment to be fully compatible with electrical, environmental, and space conditions at the site. It shall include all equipment to properly interface the AC power source to the intended load and be designed for unattended operation.

### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
CSA 22.2, No. 107.1	General Use Power Supplies
IEEE 587	Guide on Surge Voltages in AC Power Circuits Rated up to 600V
NFPA 70	National Electrical Code
NFPA 75, 1221	Electronic Computer/Data Processing Equipment
NEMA PE-1	Uninterruptible power systems standard
UL 1778	Standard for Uninterruptible Power Supply Equipment
ANSI/NEMA ICS 6	Enclosures for Industrial Controls and Systems
ANSI C62.41 Categories A and B	Recommended practice on surge voltages in low voltage power circuits
IEC 801-2	Electromagnetic Compatibility For Industrial-Process Measurement and Control Equipment
IEC 146.4	Methods of specifying performance and test requirements of uninterruptible power systems
FCC Rules and Regulations 47, Part 15, Subpart J, Class A -Certified compliance	Radio Frequency Devices

### 1.03 System Description

- A. Design Requirements
1. Load voltage and bypass line voltage will be 120 VAC, single phase 2 wire. Input voltage will be 120 VAC, single phase, 2 wire
  2. The battery shall support the UPS at 100% of rated load for at least 7 minutes at 25° C at startup

B. Modes of Operation: The UPS system shall operate as an on-line reverse transfer system in the following modes:

1. Normal: The critical AC load is 100% continuously powered by the UPS inverters. The rectifier/chargers derive power from the utility AC source and supply DC power to the inverters, while simultaneously float charging the battery.
2. Emergency: Upon failure of utility AC power, the critical AC load is powered by the inverters which, without any switching, obtain power from the battery plant. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
3. Recharge: Upon restoration of the utility AC source, the rectifier/chargers power the inverters and simultaneously recharge the battery. This shall be an automatic function and shall cause no interruption to the critical AC load.
4. Bypass: If the UPS system must be taken out of service for maintenance or repair, the static bypass switch shall transfer the load to the bypass source. The transfer process shall cause no interruption in power to the critical AC load.
5. Off-Battery: If the battery only is taken out of service for maintenance, it is disconnected from the rectifier/chargers and inverters by means of external disconnect breakers. The UPS shall continue to function and meet all of the specified steady-state performance criteria, except for the power outage back-up time capability.

C. Performance Requirements

1. The maximum working voltage, current, and di/dt of all solid-state power components and electronic devices shall not exceed 75% of the ratings established by their manufacturer. The operating temperature of solid-state component sub-assembly shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 95% of their voltage rating at the maximum rectifier charging voltage.

D. Unit Input

1. Voltage Range: +10%, -20% of nominal
2. Frequency Range:  $\pm 5\%$
3. Rectifier Walk-In/Current Limiting: 20% to 100% of full rated load over 15 seconds
4. Magnetizing Sub-cycle Inrush: Not to exceed 1.1 times normal full load input current in standard configuration.
5. Power Factor: Minimum 0.95 lagging at full load with nominal input voltage
6. Current Distortion: Less than 10% THD at full load
7. Surge Protection: Sustains input surges without damage per criteria listed in ANSI C62.41-1980 Category A & B

E. Unit Output

1. Overload capability:
  - a. 125% for ten minutes (without bypass source)
  - b. 150% for one minute (without bypass source)
  - c. 1000% for 1 cycles
2. Voltage Regulation:  $\pm 0.5\%$  for balanced load,  $\pm 1\%$  for 100% unbalanced load
3. Voltage Adjustment Range:  $\pm 5\%$  manually
4. Frequency Regulation: 0.1%

5. Efficiency: Defined as output kW/input kW at a load power factor of 0.8 lagging. Input/output; Not less than 92.5% for 120/120 VAC input/output.
6. Voltage Transients:
  - a. Manual transfer of 100% load  $\pm 3.0\%$
  - b. 100% Load Step  $\pm 2.5\%$
  - c. Loss or return of AC input power  $\pm 1\%$
7. Voltage Transient Recovery Time:
  - a. To within 1% of output voltage within one electrical cycle (16 milliseconds)
8. Voltage Harmonic Content:
  - a. 1% total harmonic distortion (THD) for linear loads
  - b. 2.5% THD for 100% nonlinear loads (3:1 crest factor) without KVA/KW de-rating
9. Fault Clearing: Sub-cycle current of at least 300% but not more than 500% of normal full load current (when bypass is not available).
10. Grounding
  - a. The AC output neutral shall be electrically isolated from the unit chassis. The unit chassis shall have an equipment ground terminal. Provisions for bonding the system neutral to the service entrance ground (customer supplied cable) shall be provided in the enclosure containing the system bypass and isolation breakers

#### **1.04 Submittals**

##### **A. Supply the UPS with Sufficient Documentation, Including the Following Manuals:**

1. Installation Manual: Submit multiple copies of the installation manual as required by Division 1 of this specification. Installation manual possesses sufficient detail and clarity to enable the Owner's technicians to install the system equipment. Supply the following Drawings and data sheets with the submittal:
  - a. Receiving and Installation Instructions
  - b. System one-line drawings
  - c. Layout drawings of the UPS control panel indicating the front door and rear panel equipment arrangement and dimension. A list of materials and components shall accompany the layout drawings.
  - d. A list of recommended standby components
  - e. Interconnection drawings
  - f. Battery wiring diagram
  - g. Accessory wiring diagrams
  - h. Line item specification compliance report
  - i. Dimension and weights
  - j. Manufacturer's literature
2. Documentation
  - a. The Vendor shall agree to furnish the Owner with service repair notes, and updates and revisions to system documentation, including software, on an automatic basis, at no charge, with sufficient copies to cover all manuals and software originally supplied.

b. As-Built Drawings

- 1) Ten (10) days prior to the start of acceptance tests, the Vendor shall provide five sets of as-built drawings showing the location, mounting details, installation details, interconnections, cable labeling, block and level diagrams, and records and results of tests performed and adjustments made.

3. Manuals

- a. Ten (10) days prior to the start of acceptance tests, the Vendor shall provide, as a minimum, the following sets of manuals:

- 1) One (1) operational manual for each piece of equipment, to include details of both hardware and software operation
- 2) Five (5) operational manual sets. Each set shall include one operational manual for each type of equipment, with the entire set bound together as a master manual (in labeled volumes if necessary).

- b. All manuals shall adhere to the following standards:

- 1) All manuals shall emphasize any notes of caution or warning that are intended to protect the operator, technician, or equipment from injury or damage
- 2) Operations manuals shall include procedures that maximize operator efficiency and insure optimum equipment life

### 1.05 Quality Assurance

- A. The UPS system shall be listed per UL Standard 1778 Uninterruptible Power Supplies, and shall be CSA Certified

- B. The Quality System for the engineering and manufacturing facility shall be certificated to conform to Quality System Standard ISO 9001 for the design and manufacture of power protection systems for computers and other sensitive electronics.

C. Manufacturer

1. Minimum of 10 years experience in the design, manufacture and testing of solid-state, UPS systems
2. ISO 9001 certification for engineering/R&D, manufacturing facilities and the field service organization

- D. Safety: List the system in accordance with UL 1778

- E. Reliability: Observed equipment mean-time-between-failure (MTBF) of at least 2 years. With the automatic bypass, the system-mission reliability of a UPS is greater than 150,000 hours.

1. The UPS features redundant power supplies. Power to the control power supplies originates from the rectifier/charger input, bypass input and system output. In the event one of the power supplies fail, the UPS continues to operate in normal mode without load de-rating. Enunciate a failed power supply condition on the monitor panel and available remotely through the RS232 port and alarm signal relay interface card. A failure alarm automatically clears when the failed power supply is replaced.
2. The UPS features redundant cooling fans. In the event one of the fans fail, the UPS continues to operate in normal mode without load derating. Enunciate a failed cooling fan condition enunciated on the monitor panel and available remotely through the RS232 port and alarm signal relay interface card. A failure alarm automatically clears when the failed fan is replaced.
3. The UPS utilizes high-reliability wiring and keyed connectors.

F. Maintainability: Calculated and demonstrated mean-time-to-repair (MTTR) not to exceed 30 minutes, including time to diagnose the problem and replace the subassembly

### **1.06 Delivery, Storage, and Handling**

A. Refer to Section 16010, 1.07 for requirements.

### **1.07 Project / Site Conditions**

A. The system withstands any combination of the following external environmental conditions without operational degradation:

### **1.08 Warranty**

A. Refer to Section 17506 for additional requirements.

B. System: No less than 24 months after acceptance and must include all costs including repair, parts, labor, travel and living expenses for the manufacturer's service personnel, within the 48 contiguous United States.

C. Battery: The UPS manufacturer warrants the battery on a prorated basis for 10 years to deliver no less than 80 percent of its rated capacity, provided the prevailing ambient temperature of the battery area does not exceed 25C (77F)

### **1.09 Maintenance**

A. Refer to Section 17506 for requirements.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

A. Allen-Bradley 1609-D, No substitutes allowed

### **2.02 Equipment and Materials**

A. Rectifier/Charger

1. The term rectifier/charger shall denote the solid-state equipment and controls necessary to convert AC to regulated DC for input to the inverter and for charging the battery.
2. Input Current Total Harmonic Distortion - Input current THD shall be less than 4.5% THD at full load, and less than 10% at 50% load.
3. Input Current Walk-In - The rectifier/charger shall provide a feature that limits the total initial power requirement at the input terminals to 20% of rated load, and gradually increases power to 100% of full rating over the 15-second time interval.
4. Input Circuit Breaker - The rectifier/charger shall have an input circuit breaker. The circuit breaker shall be of the frame size and trip rating to supply full rated load and recharge the battery at the same time. The circuit breaker shall have an under-voltage release to open automatically when the control voltage is lost.
5. Fuse Protection - Each AC phase shall be individually fused with fast-acting fuses so that loss of any semi-conductor shall not cause cascading failures. Fuses shall be bolted to bus bars at both ends to ensure mechanical and electrical integrity. The display panel on the front of the unit shall indicate a blown fuse occurring on any phase of the rectifier.
6. DC Filter - The rectifier/charger shall have an output filter to minimize ripple current into the battery. The AC ripple voltage of the rectifier DC output shall not exceed 0.5% RMS of the float

voltage. The AC ripple current in the battery during float operation shall not exceed 2% RMS of the inverter DC current. The filter shall be adequate to ensure that the DC output of the rectifier/charger will meet the input requirements of the inverter without the battery connected.

7. Battery Recharge - In addition to supplying power for the load, the rectifier/charger shall be capable of producing battery charging current sufficient to replace 95% of the battery discharge power within ten (10) times the discharge time. After the battery is recharged, the rectifier/charger shall maintain the battery at full charge until the next emergency operation.
8. Battery Configuration - The rectifier/charger shall function as specified with a single battery.
9. Temperature-Compensated Charging - The UPS shall be equipped with a battery temperature sensing unit and automatically reduce the float charge voltage in response to increases in battery temperature. Nominal float voltage shall be 540 VDC (2.25 volts per cell) at 25 degrees Centigrade. This charging setpoint will be automatically reduced 5 VDC for each temperature rise of 5 degrees Centigrade. The module LCD will indicate when the temperature compensation circuit is active.
10. Battery Load Testing - The UPS module shall be capable of performing battery load testing under operator supervision. To accomplish this, the rectifier/charger will reduce charging voltage to 1.9 volts per cell, to force the batteries to carry the load for a short period of time. If the curve of battery voltage drop indicates diminished battery capacity, the UPS will display an alarm message on the LCD. If the voltage drop indicates battery failure, the UPS will terminate the test immediately and annunciate the appropriate alarms on the LCD.

## B. Inverter

1. The term inverter shall denote the equipment and controls to convert DC from the rectifier/charger or battery to precise AC to power the load. The inverter shall be solid-state, capable of providing rated output power, and for increased performance the inverter shall be a pulse-width-modulated utilize insulated gate bipolar transistors (IGBT) and switch at no less than 30 times per cycle. Doubling of frequency is not acceptable.
2. Overload Capability - The inverter shall be able to sustain an overload across its output terminals up to 150% with  $\pm 2\%$  output voltage regulation. The inverter shall be capable of at least 300% current for short circuit conditions. If the short circuit is sustained, the inverter shall disconnect automatically from the critical load bus. An uninterrupted load transfer to bypass shall be automatically initiated, should the connected critical load exceed the capacity of the module.
3. Output Frequency - The inverter shall track the bypass continuously providing the bypass source maintains a frequency of 60 Hz  $\pm 0.5$  Hz. The inverter will change its frequency at 0.1 Hz per second (adjustable 0.01 to 1.0 Hz per second) to maintain synchronous operation with the bypass. This shall allow make-before-break manual or automatic transfers. If the bypass fails to maintain proper frequency, the inverter shall revert to an internal oscillator which shall be temperature compensated and hold the inverter output frequency to 0.1% from the rated frequency for steady-state and transient conditions. Drift shall not exceed 0.1% during any 24 hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed 0.1% from the rated frequency.
4. Fault Sensing and Isolation - Fault sensing shall be provided to isolate a malfunctioning inverter from the critical load bus to prevent disturbance of the critical load voltage beyond the specified limits. An automatic output circuit breaker shall be provided to isolate a malfunctioning module from the critical load.
5. Battery Protection - The inverter shall be provided with monitoring and control circuits to protect the battery system from damage due to excessive discharge. Inverter shutdown shall be initiated when the battery voltage has reached the end of discharge voltage. The battery

end-of-discharge voltage shall be calculated and automatically adjusted for partial load conditions to allow extended operation without damaging the battery. Automatic shutdown based on discharge time is not acceptable.

#### C. System Power Section

1. Static Bypass Switch: The term static bypass switch shall denote the solid-state device that automatically transfers the critical load to bypass without interruption if the inverter cannot supply continuous, regulated power to the critical bus.
2. Static Bypass Switch Operation - The static bypass switch shall be of the energy saving type. Once the load is transferred to the bypass line by the static bypass switch, the motor-operated system bypass circuit breaker shall automatically close removing the static bypass switch from the power flow.
3. System Bypass and UPS Output Circuit Breakers - The system power section devices shall include circuit breakers, self protecting in case of a fault in the distribution system.

#### D. System Bypass Operation

1. For times when maintenance is required or the inverter cannot maintain voltage to the load due to sustained overload or malfunction, a bypass circuit shall be provided isolating the inverter outputs from the critical bus and providing a path for power directly from an alternate AC (bypass) source. The UPS control system shall constantly monitor the availability of the system bypass circuit to perform a transfer. The system bypass circuit shall consist of a static bypass switch, a UPS output circuit breaker to isolate the inverters, and a system bypass circuit breaker in parallel with the static bypass switch. The static bypass switch shall denote the solid-state device that can instantaneously connect the alternate AC source to the load.
2. Manual Load Transfers - A manual load transfer between the inverter outputs and the alternate AC source shall be initiated from the control panel.
3. Automatic Load Transfers - An automatic load transfer between the inverter output and the alternate AC source shall be initiated if an overload condition is sustained for a time period in excess of the system output capability or due to a malfunction that would affect the output voltage. Transfers caused by overloads shall initiate an automatic retransfer of the load back to the system only after the load has returned to a level within the rating of the UPS.
4. Momentary Overloads - In the event of a load current inrush or branch load circuit fault in excess of the system rating, the static bypass switch shall connect the alternate AC source to the load for up to 16.7 milliseconds allowing up to 1000% of the normal rated output current to flow. Output voltage shall be sustained to the extent the alternate AC source capacity permits. If the overload condition is removed in less than 16.7 milliseconds, the static bypass switch will turn off and the load shall remain on UPS system power. If the overload remains, then a transfer to the alternate AC source is to be completed by closing the system bypass circuit breaker.
5. Protection and Backfeed Prevention
  - a. The critical output bus shall be protected from the flow of excess current through the static bypass switch path that may be caused by a low impedance fault at the output of the UPS system. Each phase of the bypass circuit shall be protected by individual fuses and circuit breakers. Blown fuse monitors shall indicate when a blown fuse will prevent the static bypass switch path from being available for automatic transfers.
  - b. As required by UL1778 and CSA, the static bypass switch shall not backfeed UPS power to the bypass distribution system while the UPS system is operating on battery during a bypass source power outage. The purpose of this requirement is to prevent the risk of electrical shock on the distribution system when the normal source of power is

disconnected or has failed. The static bypass switch shall be provided with redundant bypass power outage sensing circuits and disconnects. The backfeed prevention system shall operate even if two component failures exist simultaneously.

#### E. Display and Controls

1. UPS Control Panel - The term UPS control panel denotes that portion of the UPS containing the display panel and control functions. Each UPS Unit shall be provided with a control section to provide complete monitoring and control through the use of menu-prompted commands. Membrane switches shall be used to select and execute operations from a Master Menu. The display and control panel shall be mounted on the control section door.
2. Logic - System, logic and control programming shall be resident in Application Specific Integrated Circuits. Rectifier, inverter, and system control logic shall be solid state. Switches, contacts, and relays shall only be used to signal the logic system as to the status of mechanical devices or to signal user control inputs. Relays shall be used to isolate the logic for customer external status and alarm signaling.
3. Metered Values - A microprocessor shall control the display and memory functions of the monitoring system. All three phases of three-phase parameters shall be displayed simultaneously. All voltage and current parameters shall be monitored using true RMS measurements for accurate ( $\pm 1\%$ ) representation of non-sinusoidal waveforms typical of computers and other sensitive loads. The following parameters shall be displayed:
  - a. Input voltage
  - b. Input current
  - c. Battery voltage
  - d. Battery charging/discharging current
  - e. Output voltage
  - f. Output current
  - g. Output kW
  - h. Output kVA
  - i. Output frequency
4. Power Flow Indications - A power flow diagram shall graphically depict whether the load is being supplied from UPS, bypass, or battery and provide, on the same screen, the status of the following components must be indicated on the UPS Unit:
  - a. AC input circuit breaker
  - b. Battery circuit breaker
  - c. Inverter output circuit breaker
  - d. UPS output circuit breakers
  - e. Static Bypass Switch (Connected, Disconnected)
5. Battery Status Indicator - A battery status indicator at the unit shall display DC alarm conditions, shutdown voltages, the present battery voltage, and battery time remaining during discharge. A graphical representation of the battery voltage during the discharge shall be displayed. The graphical representation shall remain in the monitoring system memory until the next discharge occurs and shall be available for review of the battery performance.
6. Alarms - Alarm conditions shall be reported at the UPS and at remote location (See paragraph 2.2.8 B below for remote location alarms). The control panel shall report the alarms listed

below. Each alarm shall be visually displayed in text form and an audible alarm will sound for each alarm displayed at the UPS:

- a. Input Fail
  - b. DC Ground Fault
  - c. DC Capacitor Fuse Blown
  - d. Battery CB Open
  - e. Battery Discharging
  - f. Low Battery Warning
  - g. Low Battery Shutdown
  - h. Inverter Fuse Blown
  - i. Bypass Not Available
  - j. Hardware Shutdown
  - k. Reverse Power
  - l. Ambient Over-temperature
  - m. Equipment Over-temperature
  - n. Over-temperature Timeout
  - o. Rectifier Fuse Blown
  - p. Input Current Unbalanced
  - q. Inverter Non-synchronized
  - r. Load On Bypass
  - s. Output Under-voltage
  - t. Output Over-voltage
  - u. Output Over/Under Frequency
  - v. Overload Transfer
  - w. Manual Reset/Retransfer
  - x. DC Over-voltage Shutdown
  - y. Overload Shutdown
  - z. Bypass Phase Sequence Wrong
  - aa. Module Summary Alarm
  - bb. Communication Failure
  - cc. Emergency Off
  - dd. Overload
  - ee. Control Power Fail
  - ff. Blower Failed
7. Controls - Control functions shall be:
- a. UPS/Bypass transfer pushbuttons

- b. AC output voltage adjust  $\pm 5\%$
  - c. Emergency shut down pushbutton with protective cover
  - d. Horn Off pushbutton
  - e. Control Enable pushbutton
  - f. Display control pushbuttons: Up, Down, Select
  - g. Alarm Reset pushbutton
8. Manual Procedures - Start-up, load transfers, and shutdown procedures shall be detailed on the display panel in text and graphic form.
- a. Start-up
    - 1) Step-by-step procedure screen
    - 2) Mimic screen to indicate power flow.
  - b. Load Transfers
    - 1) Step-by-step procedure screen
    - 2) Mimic screen to indicate power flow
  - c. Shutdown
    - 1) Step-by-step procedures screen
    - 2) Mimic screen to indicate power flow

#### F. Self-Diagnostics

1. Present Status Screen - The control system shall monitor and display all of the following parameters in a Present Status screen:
  - a. Input Voltage, Line-to-Line for all three phases (M)
  - b. Input Current for all three phases (M)
  - c. Bypass Voltage, Line-to-Line for all three phases (SCC)
  - d. Output Voltage, Line-to-Line for all three phases (B)
  - e. Output Current for all three phases (B)
  - f. Output Frequency (B)
  - g. Battery Voltage (M)
  - h. Battery Amps (M)
  - i. Load kVA (B)
2. Event History File - The control system shall maintain an event history of the alarm conditions that have occurred during system operation.
3. System Status File - The control system shall monitor and display the total operating hours of the UPS system.
4. Diagnostic Aids - The UPS shall be provided with the following built-in diagnostics for troubleshooting and circuit alignment aids:
  - a. Rectifier in control mode
  - b. UPS synchronizing with bypass
  - c. Positive DC bus ground fault

- d. Negative DC bus ground fault
  - e. Bypass frequency higher than system output frequency
  - f. Bypass frequency lower than system output frequency
  - g. Automatic static bypass switch lockout
  - h. Command given to close UPS system output circuit breaker
  - i. Command given to close system bypass circuit breaker
  - j. Command given to open UPS system output circuit breaker/bypass circuit breaker
  - k. Degree of overload
  - l. Undervoltage release for battery disconnect switch
  - m. Undervoltage release for input circuit breaker
5. Site Monitoring Capability - UPS control circuits shall be capable of interfacing with central site monitoring systems via the alarm signal relay interface card, built into the UPS. The site monitoring signal-processing module shall be built into the system logic. The following shall be available for display:
- a. Metering
  - b. Bypass volts (line-line, all phases)
  - c. Critical bus volts (line-line & line-neutral, all phases)
  - d. Critical bus current (all phases)
  - e. Critical bus frequency
  - f. Critical bus kVA
  - g. Critical bus kW
  - h. DC volts
  - i. Battery amps ( $\pm$ )
  - j. % Capacity
  - k. Digital Alarms
  - l. Fuse Cleared
  - m. Output Overload
  - n. Emergency Power Off
  - o. Ambient Overtemperature
  - p. Battery Discharging
  - q. Low Battery Reserve
  - r. Load On Bypass
  - s. Static Switch Disabled
  - t. Battery Disconnected
  - u. Module Cooling Failure
  - v. Control Power Failure

6. The UPS control communication circuits shall also download operational data for analysis, upon request from a local or remote terminal (RS-232-C format). Information available for display shall include all alarms and system parameters contained in the present status, event history, and history status files.
7. Simultaneous Communications
  - a. Site monitoring, and auto-dial communications as described above shall be available simultaneously.
- G. Battery "Hot swappable" System or Disconnect Breaker - The UPS module shall automatically be disconnected from the battery by the "Hot Swappable System" or by opening its breaker when the battery reaches the minimum discharge voltage level or when signaled by other control functions.
- H. Battery Power Pack
  1. Internal Battery Power Pack
    - a. The battery power pack shall consist of sealed, valve-regulated batteries "hot swappable system" or circuit breaker for isolating the battery pack from the UPS. The battery cells and disconnect breaker shall be installed and housed in the UPS.
    - b. The battery system shall be sized to support an 800 W load for no less than 7 minutes. The battery system shall provide 100% initial capacity upon delivery.
  2. The battery shall be lead-calcium, sealed, valve-regulated type with a one (1) year full warranty and a nine (9) year pro rata warranty under full float operation. The battery design shall utilize absorbent glass mat (AGM) technology to immobilize the electrolyte. There shall be two such systems, one per each UPS module.

## **2.03 Fabrication**

### **A. Materials**

1. All materials of the UPS shall be new, of current manufacture, high grade and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. All power semi-conductors shall be hermetically sealed. Control logic and fuses shall be physically isolated from power train components to ensure operator safety and protection from heat. All electronic components shall be accessible from the front without removing sub-assemblies for service access.

### **B. Wiring**

1. Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code, OSHA, and applicable local codes and standards. All bolted connections of bus bars, lugs, and cables shall be in accordance with requirements of the National Electric Code and other applicable standards. All electrical power connections shall be torqued to the required value and marked with a visual indicator.
2. Provisions shall be made in the cabinets to permit installation of input, output, and external control cabling, using raceway or conduit. Provision shall be made for bottom access to input and output connection cabinets. In conformance with NEC, connection cabinets shall provide for adequate wire bend radius. All copper bus bars for customer connections shall be tin plated for connection integrity.

### **C. Construction and Mounting**

1. The UPS shall be in NEMA Type 1 enclosures, designed for floor mounting. The UPS shall be structurally adequate and have provisions for hoisting, jacking, and forklift handling. Maximum cabinet height shall be 80 inches.

## D. Cooling

1. Adequate ventilation shall be provided to ensure that all components are operated well within temperature ratings. The cabinet blowers shall be redundant so that a single blower failure will not cause temperatures to increase beyond acceptable limits.
2. Temperature sensors shall be provided to monitor UPS internal temperature. Upon detection of temperatures in excess of manufacturer's recommendations, the sensors shall cause audible and visual alarms to be sounded on the UPS control panel. A separate room ambient temperature sensor shall be provided to give an alarm if the temperature of the inlet air to the UPS is above specified limits. Air filters shall be located at the point of air inlet and be changeable without opening cabinet doors. No service clearance or ventilation shall be required in the rear of the system,

## PART 3 - EXECUTION

### 3.01 Installation

- A. Install in accordance with manufacturer's instructions.

### 3.02 Field Quality Control

- A. Perform the following procedures and tests by field service personnel during the UPS startup:

1. Visual Inspection
  - a. Visually inspect all equipment for signs of damage or foreign materials.
  - b. Observe the type of ventilation, the cleanliness of the room, the use of proper signs, and any other safety related factors.
2. Mechanical Inspection
  - a. Check all the power connections for tightness.
  - b. Check all the control wiring terminations and plugs for tightness or proper seating.
3. Electrical Pre-check
  - a. Check the DC bus for a possible short circuit.
  - b. Check input and Bypass power for proper voltages and phase rotation.
  - c. Check all lamp test functions.
4. Initial UPS Startup
  - a. Verify that all the alarms are in a "go" condition.
  - b. Energize the system and verify the proper DC, walkup, and AC phase on.
  - c. Check the DC link holding voltage, AC output voltages, and output wave forms.
  - d. Check the final DC link voltage and Inverter AC output. Adjust if required.
  - e. Check for the proper synchronization.
  - f. Check for the voltage difference between the Inverter output and the Bypass source.
  - g. Provide maintenance manuals.

- B. Operational Training: Before leaving the site, the field service engineer familiarizes responsible personnel with the operation of the UPS. The UPS equipment is available for demonstration of the modes of operation.

### C. Manufacturer's Field Service

1. Field Engineering Support: The UPS manufacturer employs a nationwide field service department staffed by factory trained field service engineers dedicated to startup, maintenance, and repair of UPS equipment. The organization consists of local offices managed from a central location. Deploy field engineers to the site to provide on site emergency response within 24 hours. A map of the United States showing the location of all field service offices must be submitted with the proposal.
2. Spare Parts Support: Locate parts supplies in the field to provide 80 percent of all emergency needs. The factory serves as the central stocking facility where a dedicated supply of all parts is available within 24 hours.
3. Maintenance Contracts: Provide and offer a complete range of preventative and corrective maintenance contracts with the proposal. Under these contracts, the manufacturer maintains the user's equipment to the latest engineering levels as they are developed.

### D. Training

1. Training Classes (basic startup & operating training only).
  - a. Immediately prior to system turn-up, the Contractor shall conduct training class regarding startup and maintenance issues related to the UPS including how to replace batteries or any other consumable components. The train session shall be provided for up to two District Staff members and shall be a minimum of two hours in duration per site.

**\*\*END OF SECTION\*\***

## SECTION 16325 DRY-TYPE TRANSFORMERS

### PART 1 - GENERAL

#### 1.01 Summary

- A. Scope: This section provides specifications for all transformers with primaries of 600V or less and ratings up to 112.5 kVA.
- B. Type: All transformers shall be of the dry type

#### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
IEEE C57.96	Guide for Loading Dry Type Transformers
NECA 409	Recommended Practice for Installing and Maintaining Dry-Type Transformers
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ST 20	Dry-Type Transformers for General Applications
NEMA TP 1	Guide for Determining Energy Efficiency for Distribution Transformers
NFPA 70	National Electrical Code
UL 486E	Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors
UL 489	Standard for Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures
UL 1561	Standard for Dry-Type, General Purpose, and Power Transformers

#### 1.03 Submittals

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

#### 1.04 Quality Assurance

- A. Performance and Design Requirements: General: Unless an integral part of a motor control center, the dry type transformers shall be either wall or floor mounted. The coil and core shall be installed on a vibration isolation mounting. Coils shall be copper wire wound and epoxy encased. Where transformers are mounted within motor control centers or variable frequency drive units, they shall be open type protected with insulating barriers. The secondary voltage, kVA and the type of connections shall be as shown on the drawings. The units shall have separate primary and secondary windings.
- B. Operating Requirements: The dry type transformers shall have a primary voltage of 480 volts, 3-phase or 1-phase as indicated on the drawings. The primary tap arrangement shall be 2 - 2-1/2 percent above and 4 - 2-1/2 percent below, the normal 480 volt primary voltage. Winding

insulation shall be Class B or Class F with rated temperature rises not to exceed 80 degrees C at 40 degrees C ambient temperature when measured by the resistance method.

- C. Standards: Transformer sound levels: NEMA ST 1 4 11.
- D. Conform to requirements of the NEC, latest adopted version with amendments by local authority having jurisdiction (AHJ).
- E. Furnish products listed by UL or other testing firm acceptable to AHJ.

### **1.05 Project / Site Conditions**

- A. The transformers may be installed indoors in a water facility. The ambient temperature may range from 10 degrees F to 115 degrees F. Relative humidity may range from 10 to 100 percent. In some installations, the equipment will be subjected to small amounts of dust, hydrogen sulfide gas and may operate in damp rooms that are not force ventilated.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. Eaton Electrical, Federal Pacific, General Electric, Jefferson Electric, Siemens, Square D or approved equal.

### **2.02 Equipment and Materials**

- A. Dry type transformers shall have enclosures of 12-gage steel with ventilating openings. The enclosure shall be degreased, phosphatized, and finished in ANSI 61 baked gray enamel.
- B. Provide transformer coils of the continuous wire wound construction and impregnate with non-hygroscopic, thermosetting varnish prior to baking.
- C. Maximum temperature rise at full load NEMA TP-1 compliant, 80 degrees above 40C ambient temperature.
- D. Provide each coil layer with end fillers or tie-downs to provide maximum mechanical strength. Braze tap terminations to magnet wire. Primary and secondary magnet wire to be brazed directly to bus stubs or lugs firmly mounted.
- E. Provide windings continuous from start to finish. Splicing is unacceptable. Materials incorporated must have at least a minimum of 1 year of proven field usage. Accelerated laboratory test not acceptable.
- F. All cores manufactured from a high-grade, non-aging silicon steel with high magnetic permeability, low hysteresis and eddy current losses. Magnetic flux densities are kept well below saturation to allow for a minimum of 10 percent over-voltage excitation.
- G. Cut all laminations with direction of grain and be free from burrs, core plated, and stacked without gaps.
- H. Maximum case temperature, 35C above ambient
- I. Sound levels guaranteed by manufacturer, 45dB through 150KVA and 50dB through 300KVAh

### **2.03 Fabrication**

- A. Clamp cores with structural angles and bolted to enclosure to prevent damage during shipment or rough handling.
- B. Provide lifting brackets on all sizes.

- C. Ventilated openings must be designed in a manner as to prevent accidental access to live parts.
- D. Degrease, clean, phosphatize, prime and finish all enclosures with a gray, baked enamel. Visibly ground the core of the transformer to this enclosure by means of a flexible ground strap.
- E. Mount all transformers, core and coil, on vibration mounting pads designed to suppress transmission of 120 cycle frequencies and harmonics thereof. Arrange and select pads in consideration of core and coil weight. Provide additional noise suppressing mountings external to transformers where transformers are located in mechanical spaces.
- F. Transformer Supports: Provide additional vibration isolation hangers and pads, brackets and supports as may be required for a complete installation.
- G. Winding Taps
  - 1. Less than 15KVA: 4-2-1/2 percent FCBN, FCAN.
  - 2. 15KVA and Larger: 4-2-1/2 percent-2+2-.
- H. Provide weather resistant enclosure and factory rating for exterior where shown at exterior locations.
- I. Provide non-ventilated transformer where shown in areas where airborne combustible or conductive particles are present, where transformer is subject to spray from any direction, or where dust conditions are extreme.
- J. Lugs: Provide mechanical type lugs for conductor terminations

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. All equipment shall be installed so that it is readily accessible for operation and maintenance.
- B. The transformer manufacturer shall furnish certified test data on efficiency and no load power factor prior to acceptance. After completion of installation, each transformer and associated load equipment shall be tested individually and as a combined unit to ensure that each unit is properly connected and operating as required and as specified.
- C. Comply with all other applicable Sections of this Specification. Transformers up to 45KVA may be floor mounted, wall mounted or suspended where so indicated on Drawings. Floor mount all transformers above 45KVA rating.
- D. Provide transformers with concrete working or housekeeping pad minimum 8 inches larger than transformer and minimum 3 inches above finish grade. Install plumb and level. Provide exterior pads of 2500 to 3000 psi concrete reinforced with 8 gauge wire fabric or No. 6 reinforcing bars on 12-inch centers. Provide 10-inch thick base of gravel below pad for support. Pad extends 6 inches on all sides from the exterior most prominent dimension. Provide 3/4-inch by 10-foot ground rod at each corner thermally bonded to No. 2 copper ground conductor, bonded to transformer, and concrete reinforcement.
- E. Do not mount transformers closer to combustible materials than allowed by NEC. Provide adequate ventilation; mount transformers away from adjacent surfaces as recommended by manufacturer.
- F. Provide transformers with 8-inch round by 24-inch (above and below grade) concrete and steel bollards where subject to vehicular traffic.
- G. Mount transformers on vibration isolating pads suitable for isolating the transformer housing from building structure.

- H. Use flexible conduit, 18 inches minimum length, for connections to transformer case. Make connections to side panel or bottom of enclosure. Include ground conductor in flex.
- I. Provide seismic restraints per local requirements.
- J. Mount wall mounted transformers with a minimum of 6'-6" headroom below unit.
- K. Where transformers are grouped exterior together or with switchgear, refinish transformer or switchgear resulting in transformers and switchgear finishes matching in color and type

### **3.02 Field Quality Control**

#### **A. Testing**

1. The transformer manufacturer shall furnish certified test data on efficiency and no load power factor prior to acceptance. After completion of installation, each transformer and associated load equipment shall be tested individually and as a combined unit to ensure that each unit is properly connected and operating as required and as specified.
  2. Check for damage and tight connections prior to energizing transformers.
  3. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Revise the installation of noisy units to achieve an acceptable noise level or replace with a new unit with an acceptable sound level.

**\*\*END OF SECTION\*\***

# SECTION 16330 VARIABLE FREQUENCY DRIVES

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This section provides specifications for variable frequency drive (VFD) units as indicated in the contract drawings.
- B. Type
1. All variable frequency drive units shall be of the fully integrated 6-pulse solid state type.

### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
EIA, TIA: 359-1	Special Colors
IEEE 112	Standard Test Procedure for Polyphase Induction Motors and Generators
IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electric Power Systems
IEEE C62.41	Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits
NEMA CP 1	Shunt Capacitors
NEMA MG 1	Motors and Generators
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA WC-57	Control Cables
NFPA	Electrical Standard for Industrial Machinery

### 1.03 System Description

- A. General: The variable frequency drive units shall convert 60 Hz input power to adjustable frequency output power. The output voltage of the inverter shall be adjustable and controlled by the value of output frequency to maintain a constant ratio of volts per hertz throughout the operating range. The inverter shall be capable of varying the speed of any standard NEMA B design squirrel cage induction motor with a 1.15 service factor. It shall do this without de-rating and without requiring any motor modifications.
- B. Operating Requirements: All VFD units shall be of the mechanical group type as shown. The mechanical groupings of VFD units shall have the following power input/output specifications:
1. Voltage
    - a. Input: 380-480 Vac
    - b. Output: 0 to 460 Vac (rated motor voltage)
  2. Frequency

- a. Input: 47-63 Hz
- b. Output: 0 to 650 Hz
- 3. Phases
  - a. Input: 3 Phase
  - b. Output: 3 Phase
- 4. No. of Wires
  - a. Input: 3
  - b. Output: 3
- C. Incoming feeder line connection shall be in accordance with the VFD elevation and single-line diagram.
- D. Power shall be provided to the variable frequency drive units from the main bus by conductors which shall have a minimum 100-ampere rating unless the drive unit requires greater capacity. VFD units shall be bonded to the ground system.
- E. The VFD units shall be supplied by the same system integrator responsible for supplying the motor control centers and the control panels

#### **1.04 Submittals**

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

#### **1.05 Quality Assurance**

- A. General: All equipment shall be installed, aligned and tested under the supervision of installation specialists, factory trained by the equipment manufacturers. As a condition precedent to final acceptance of the work, the Contractor shall furnish the Contract Manager with copies of the manufacturer's certifications stating that the equipment has been properly installed, aligned and tested and meets all requirements for satisfactory performance under the conditions specified herein. The Contractor shall coordinate with the instrumentation and mechanical contractors for assurance that all control components are compatible. Nothing in this provision, however shall be construed as relieving the Contractor of his overall responsibility for this portion of the work.
- B. Harmonic Filters: The VFD shall operate satisfactorily when connected to a bus supplying other solid state power conversion equipment which may be causing up to 10 percent total harmonic distortion and commutation notches up to 36,500 volt microseconds, or when other VFDs are operated from the same bus.
- C. Individual or simultaneous operation of the VFDs shall not add more than 5 percent total harmonic voltage distortion to the bus per IEEE 519, 1992. The main breaker for the Main Switchboard shall be the point of common coupling.
- D. Maximum allowable total and individual harmonic, current distortion shall not exceed the limits set forth by IEEE 519, 1992. If additional harmonic filters are required to meet these requirements, the VFD manufacturer shall provide such filters and shall be responsible for the design and manufacturing of the filters. A preliminary harmonic analysis which includes all harmonics to the ninety-ninth harmonic must be submitted by the manufacturer for review by the Engineer. The Contractor shall employ an independent testing company to perform actual harmonic analysis at the point of common coupling, with and the VFDs operating. The tests shall demonstrate compliance with the harmonic requirements of these specifications using various combinations of VFDs from single to maximum allowed operation as allowed by the control strategies.

## **1.06 Delivery, Storage, and Handling**

A. Refer to Section 16010, 1.07 for requirements.

## **1.07 Project / Site Conditions**

- A. For motor loads below 100 HP, the VFD units will be installed indoors within Motor Control Centers as shown on the contract drawings.
- B. For motor loads above 100 HP, the VFD units will be installed indoors and housed in separate free-standing force air ventilated enclosures.
- C. Temperatures are expected to range from 10 degrees F and 115 degrees F. Relative humidity is expected to vary from 35 percent to 100 percent

## **1.08 Warranty**

A. Refer to Section 17506 for requirements.

## **1.09 Maintenance**

A. Refer to Section 17506 for requirements.

# **PART 2 - PRODUCTS**

## **2.01 Manufacturers**

- A. VFD's shall be heavy duty rated and by same manufacturer as the supplied and integrated into the motor control center:
  - 1. Square-D/Schneider Electric
  - 2. Allen Bradley/Rockwell Automation
  - 3. Eaton

## **2.02 Equipment and Materials**

- A. Where shown on the drawings, adjustable frequency drives 15 through 100 Horsepower (HP), Variable Torque (VT) shall have the following features:
  - 1. The VFD shall be rated for 480 Vac. The VFD shall provide microprocessor-based control for three-phase induction motors. The controller's full load output current rating shall be based on 50 degree C ambient at 250HP and below and 40 degree ambient above 250HP VT and no less than a 3.6 kHz switching frequency to reduce motor noise and avoid increased motor losses. Drive shall have been tested to and UL listed as conforming to the requirements of UL508C at rated load currents and ambient temperature per this specification. Drive shall have a UL listed interrupting rating of 65kaIC.
  - 2. The VFD shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Adjustable Current Source VFD are not acceptable. Insulated Gate Bipolar Transistors (IGBT's) shall be used in the inverter section. Bipolar Junction Transistors, GTO's or SCR's are not acceptable. The VFD shall run at the above listed switching frequency.
  - 3. The VFD shall have an efficiency at full load and speed that exceeds 95%. The efficiency shall exceed 90% at 50% speed and load. The VFDs shall maintain the line side displacement power factor at no less than 0.96, regardless of speed and load.

4. 6 pulse drive shall include the following protective features, as a minimum: Input line fuses, Metal Oxide Varistor (MOV), and Input choke rated 7.5% of rated line current.
5. The VFDs shall have a one (1) minute overload current rating of 110% for variable torque loads.
6. The VFDs shall be capable of operating of operating any NEMA design B squirrel cage induction motor, regardless of manufacturer, with a horsepower and current rating within the capacity of the VFD.
7. The harmonics introduced by the adjustable frequency drives at the point of common coupling (PCC) shall meet the requirements of IEEE519-1992 for General Systems. For purposes of this specification the PCC shall be the utility feeder to the facility where multiple users are served. Short circuit amperes at this point and total demand load are noted on the system one line drawing. 6 pulse drives shall have manufacturer documented maximum current distortion of 5.5% to ensure harmonic compliance.
8. For this system that has a standby generator, the harmonic distortion shall meet the distortion levels shown in table 10.3 of IEEE519-1992 for  $ISC/IL < 20$ . The contractor shall provide the following data for the standby generator in order to perform the calculations: Voltage, kW, kVA and Subtransient Reactance ( $X''_d$ ), and total maximum demand ampere load for generator operation.
9. A harmonic analysis of the system shall be made consisting of the current and voltage harmonics expected from the addition of the adjustable frequency drives for all harmonics through the 25th per tables 10-2 and 10-3 of IEEE519-1992. This analysis shall be included as part of the bid submittal. An 6 pulse rectifier with an integral pre-wired phase shifting transformer for each drive shall be required as part of this specification. The transformer shall be a single wound transformer rated 480 Volts with a UL recognized 180 degree C insulation system. Required performance shall be obtained without exceeding the above indicated temperature rise in a 50 degree C ambient below 250HP and for 40° C maximum ambient above 250HP.
10. The use of harmonic filter traps, 12 pulse rectifiers, Active filters or Active converter sections is not an acceptable substitute to the 6 pulse drive.
11. The VFD shall be able to start into a spinning motor. The VFD shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFD shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.
12. Standard operating conditions shall be:
  - a. Incoming Power: Three phase, 480 Vac (+10% to -10%) and 60 Hz (+/-5 Hz) power is converted to a fixed potential DC bus level. Maximum input voltage unbalance shall be 0.5% as defined in NEMA MG 1 section 14.35.2
  - b. Frequency stability of +/-0.05% for 24 hours with voltage regulation of +/-1% of maximum rated output voltage.
  - c. Speed regulation of +/- 0.5% of base speed.
  - d. Load inertia dependant carry over (ride through) during utility loss.
  - e. Insensitive to input line rotation.
  - f. Humidity: 0 to 95% (non-condensing and non-corrosive).
  - g. Altitude: 0 to 3,300 feet (1000 meters) above sea level.
  - h. Ambient Temperature: 0 to 50 degree C.

- i. Storage Temperature: -40 to 60 degree C.

### 13. Control Functions

- a. Frequently accessed VFD programmable parameters shall be adjustable from a digital operator keypad located on the front of the VFD. The VFD shall have a 3 line alphanumeric programmable display with status indicators. Keypads must use plain English words for parameters, status, and diagnostic messages. Keypads that are difficult to read or understand are not acceptable, and particularly those that use alphanumeric code and tables. Keypads shall be adjustable for contrast with large characters easily visible in normal ambient light.
- b. Standard advanced programming and trouble-shooting functions shall be available by using a personal computer's Ethernet port and Windows™ based software. In addition the software shall permit control and monitoring via the VFD Ethernet port. The computer software shall be used for modifying the drive setup and reviewing diagnostic and trend information as outlined in this section through section 18.
- c. The operator shall be able to scroll through the keypad menu to choose between the following:
  - 1) Monitor
  - 2) Operate
  - 3) Parameter setup
  - 4) Actual parameter values
  - 5) Active faults
  - 6) Fault history
  - 7) LCD contrast adjustment
  - 8) Information to indicate the standard software and optional features software loaded.
- d. The following setups and adjustments, at a minimum, are to be available:
  - 1) Start command from keypad, remote or communications port
  - 2) Speed command from keypad, remote or communications port
  - 3) Motor direction selection
  - 4) Maximum and minimum speed limits
  - 5) Acceleration and deceleration times, two settable ranges
  - 6) Critical (skip) frequency avoidance
  - 7) Torque limit
  - 8) Multiple attempt restart function
  - 9) Multiple preset speeds adjustment
  - 10) Catch a spinning motor start or normal start selection
  - 11) Programmable analog output
  - 12) DC brake current magnitude and time
  - 13) Proportional/Integral/Differential (PID) process controller

### 14. The VFDs shall have the following common system interface requirements:

- a. Inputs - A minimum of three (3) programmable digital inputs, two (2) analog inputs and network communications interface shall be provided with the following available as a minimum:
  - 1) Remote manual/auto
  - 2) Remote start/stop
  - 3) Remote forward/reverse
  - 4) Remote preset speeds
  - 5) Remote external fault
  - 6) Remote fault reset
  - 7) RUN/Start Disable
  - 8) Process control speed reference interface, 4-20mA
  - 9) PTC
- b. Ethernet communications – Provide a minimum of two (2) EtherNet/IP ports.
- c. Outputs – A minimum of two (2) discrete programmable digital outputs, one (1) programmable open collector output, and one (1) programmable analog output shall be provided, with the following available at minimum.
  - 1) Programmable relay outputs with one (1) set of form C contacts for each, selectable with the following available at minimum:
    - a) Fault
    - b) Run
    - c) Ready
    - d) Reversing
    - e) Jogging
    - f) At speed
    - g) In torque limit
    - h) Motor rotation direction opposite of commanded
    - i) Over-temperature
- d. Programmable open collector output with available 24VDC power supply and selectable with the following available at minimum:
  - 1) Fault
  - 2) Run
  - 3) Ready
  - 4) Reversing
  - 5) Jogging
  - 6) At speed
  - 7) In torque limit
  - 8) Motor rotation direction opposite of commanded
  - 9) Over-temperature

- e. Programmable analog output signal, selectable with the following available at minimum:
  - 1) Output current
  - 2) Output frequency
  - 3) Motor speed
  - 4) Motor torque
  - 5) Motor power
  - 6) Motor voltage
  - 7) DC link voltage

#### 15. Monitoring and Displays

- a. The VFD display shall be a LCD type capable of displaying three (3) lines of text and the following thirteen (13) status indicators:
  - 1) Run
  - 2) Forward
  - 3) Reverse
  - 4) Stop
  - 5) Ready
  - 6) Alarm
  - 7) Fault
  - 8) Local
  - 9) Panel
  - 10) Remote
  - 11) Hand
  - 12) Auto
  - 13) Off
- b. The VFD keypad shall be capable of displaying the following monitoring functions at a minimum:
  - 1) Output frequency
  - 2) Output speed
  - 3) Motor current
  - 4) Motor torque
  - 5) Motor power
  - 6) Motor voltage
  - 7) DC-link voltage
  - 8) Heatsink temperature
  - 9) Total operating days counter
  - 10) Operating hours (with reset function)
  - 11) Total megawatt hours

- 12) Megawatt hours (with reset function)
- 13) Voltage level of analog input
- 14) Current level of analog input
- 15) Digital inputs status
- 16) Digital and relay outputs status
- 17) Motor temperature rise, percentage of allowable.

16. Protective Functions

a. The VFD shall include the following protective features at minimum:

- 1) Over-current
- 2) Over-voltage
- 3) Inverter fault
- 4) Under-voltage
- 5) Phase loss
- 6) Output phase loss
- 7) Under-temperature
- 8) Over-temperature
- 9) Motor stalled
- 10) Motor over-temperature
- 11) Motor under-load
- 12) Logic voltage failure
- 13) Microprocessor failure
- 14) DC injection braking

b. The VFD shall provide ground fault protection during power-up, starting, and running. VFD with no ground fault protection during running are not acceptable.

17. Diagnostic Features

a. Fault History

- 1) Record and log faults
- 2) Indicate the most recent first, and store up to 9 faults.

18. HMCP or thermal magnetic breaker to provide a disconnect means. Operating handle shall be flange mounted. The disconnect shall not be mounted on the door. The handle position shall indicate ON, OFF, and TRIPPED condition. The handle shall have provisions for padlocking in the OFF position with at least three (3) padlocks. Interlocks shall prevent unauthorized opening or closing of the VFD door with the disconnect handle in the ON position. Door handle interlock can be defeated by qualified maintenance personnel.

19. Laminated plastic nameplate engraved with user's identifying name or number for oversize enclosures.

20. 120 Vac control to allow VFD to interface with remote dry contacts.

21. Motor dv/dt filter for use on motor cable runs exceeding 100 feet for motors with a peak voltage insulation rating less than 1600 Vac.

- a. The dv/dt filter shall be located at the VFD and shall reduce the dv/dt clamp any voltage overshoots of the VFD output. It will return the energy in the voltage overshoots to the VFD Dc bus. A power dissipating resistance device is not acceptable.
22. Provide an input EMI filter to minimize conducted electrical noise to meet the requirements of IEC 61800-3.
23. Enclosure
- a. The VFD enclosure shall be UL listed type enclosure NEMA 1 filtered and gasketed. The VFD shall have complete front accessibility with easily removable assemblies.
24. Spare Parts
- a. The main logic board, keypad and power supply board shall be supplied as spares, one for each different part number supplied.
25. Programming Accessories
- a. If VFD has provisions for connection to a computer for download data or storing or changing VFD parameters, provide a set of the required computer cables.
26. The VFD manufacturer shall maintain, as part of a national network, engineering service facilities within 100 miles of project to provide start-up service, emergency service calls, repair work, service contracts, maintenance and training of customer personnel.
27. Nameplates: An engraved, plastic nameplate with white letters on a black background shall be provided for each compartment. The nameplate shall indicate equipment controlled, and as shown on the single-line diagram. The nameplates shall be 1-inch by 1-1/2 inches and fastened to the compartment door with stainless steel hardware.

## **PART 3 - EXECUTION**

### **3.01 Factory Testing**

- A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of UL and NEMA standards.
1. All printed circuit boards shall be functionally tested via automatic test equipment prior to unit installation.
  2. All inverter power sub-assemblies shall undergo a burn-in test.
  3. After all pre-tests have been performed, each complete VFD shall undergo a burn-in test. The drive shall be burned in with a motor load without an unscheduled shutdown.
- B. The manufacturer shall provide three (3) certified copies of complete VFD final test reports

### **3.02 Installation**

- A. Variable frequency drives shall be located in separate free-standing enclosures as indicated on the contract drawings.
- B. The system integrator shall employ personnel that are skilled and experience in the installation, testing and startup of VFDs along with accessories. All installation labor shall be performed by qualified personnel who have had experience on similar projects.
- C. The Contractor shall ensure that all equipment and materials fit properly in their installation.
- D. Any work or rework required to correct improper installations shall be performed at no additional costs to the Owner.

- E. All manufacturers' instructions shall be followed regarding the handling, receiving, installation, and pre-check requirements prior to energization.
- F. Once the VFD units are energized, all manufacturers' instructions shall be followed regarding programming, set-up and calibration of equipment.

### **3.03 Field Quality Control**

- A. The services of a qualified representative of the VFD manufacturer shall be furnished to inspect the installation, place it in operation, make any necessary adjustments, and instruct the plant personnel in its operation and maintenance. A minimum of eight hours training shall be provided.
- B. The Manufacturer's Representative shall provide start-up service including site inspection, final adjustments, operational checks, functional checks, and a startup record. The start-up engineer shall measure actual harmonics on the system on both the utility and generator with a Dranetz or BMI harmonic spectrum analyzer.
- C. The Contractor under the technical direction of the manufacturer's service representative shall perform the following minimum work.
  - 1. Inspection and final adjustments.
  - 2. Operational and functional checks of VFD and spare parts.
  - 3. The contractor shall certify that he has read the drive manufacturer's installation instructions and has installed the VFD in accordance with those instructions.
  - 4. The Contractor shall provide three (3) copies of the manufacturer's field start-up report before final payment is made.

### **3.04 Maintenance/Warranty Service:**

- A. Warranty to commence 12 months from the date of start-up, not to exceed 18 months from the date of shipment.

### **3.05 Field Testing**

- A. The VFD manufacturer shall perform harmonic measurements at the point where the utility feeds multiple customers (PCC) to verify compliance with IEEE519-1992. A report of the voltage THD and current TDD shall be sent to the engineer. The contractor shall provide labor, material, and protection as needed to access the test points. The readings shall be taken with all drives and all other loads at full load, or as close as field conditions allow.
- B. After the installation of the pumps, VFD's and all controls and appurtenances, the pumps shall be subjected to a field running test under actual operating conditions. The field tests shall be made in the presence of the Contract Manager. The field tests shall demonstrate that under all conditions of operation the unit:
  - 1. Has not been damaged by transportation or installation.
  - 2. Has been properly installed.
  - 3. Has no mechanical defects.
  - 4. Has been properly connected.
  - 5. Is in proper alignment.
  - 6. Is free of overheating of any parts.
  - 7. Is free of all objectionable vibration.
  - 8. Is free of excessive noise.

- 9. Is free of overloading of any parts.
- 10. Shall operate as specified with the control system.
- C. Record all VFD parameter setting as configured in the field. Data shall be included in the O& M Manual.

**3.06 Adjusting / Cleaning / Protection**

- A. Vacuum clean all interior equipment.

**\*\*END OF SECTION\*\***

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## SECTION 16400 ELECTRIC SERVICE

### PART 1 - GENERAL

#### 1.01 Summary

##### A. Scope:

1. This section provides specifications for the electric service requirements associated with the project site.
2. The work of this section consists of furnishing and installing service entrance equipment, raceways, and conductors to replace the existing service entrance equipment.

##### B. Coordination

1. Permanent electric power of the phasing, voltage, and characteristics shown will be supplied by the Owner. Coordinate all work with the Owner. Where work by Owner is required in conjunction with construction, such as installation of cable in common trench with other utilities, the Contractor is responsible for coordinating the work and ensuring that all required work is completed.

#### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
PG&E Standards	Electric & Gas Service Requirements, latest Edition.
IEEE C37.13	Standard For Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.50	Switchgear – Low Voltage AC Power Circuit Breakers Used Enclosures – Test Procedures
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NFPA 70	National Electrical Code
UL 489	Standard for Safety Molded-Case Circuit Breakers and Circuit Breaker Enclosures

#### 1.03 System Description

- A. A new indoor utility service switchboard including meter, main circuit breaker and automatic transfer switch shall be provided as shown on the contract drawings.

#### 1.04 Submittals

- A. Submittals shall comply with the provisions set forth in Section 01300 and Section 16010.

#### 1.05 Quality Assurance

- A. The electrical service shall meet the requirements of the power company.
- B. All work shall meet the requirements of the power company.

## **1.06 Delivery, Storage, and Handling**

A. Refer to Section 16010 – General Electrical Provisions, 1.06 for requirements.

## **1.07 Project / Site Conditions**

A. All materials used in connection with the electrical service will be installed in a water facility. Temperatures are expected to range from 10 degrees F and 115 degrees F. Relative humidity is expected to range from 10 percent to 100 percent.

## **PART 2 - PRODUCTS**

### **2.01 Equipment and Materials**

A. Equipment

1. Service Raceway
  - a. Underground
  - b. Size and material shown
  - c. Install nylon pull cords of 100-pound test instead of pull wires in all unused conduit
2. Service Conductors
  - a. Contractor shall provide conduit and secondary conductors from new PG&E transformer.
3. Service Disconnect
  - a. UL listed as “Service Entrance Equipment”, externally operable and plainly marked whether in open or closed position, and capable of interrupting the maximum symmetrical short circuit current available. Press connectors shall be provided for attachment of service conductors.
4. Meter Socket
  - a. Type approved by Power Company.

### **2.02 Components and Accessories**

A. Meters

1. Power Company furnished

## **PART 3 - EXECUTION**

### **3.01 Preparation**

- A. The Contractor shall make all equipment approval arrangements and scheduling with PG&E to provide a new utility service connection to the new meter location. The Contractor shall schedule within 30 days after award of contract service installation and connection with PG&E.
- B. The Contractor shall obtain PG&E Engineered drawings necessary for this project including but not limited to service conductor conduits, pole risers, pull boxes, vaults, wire size requirements and pull rope requirements.

### **3.02 Installation**

A. Service Raceway

1. The Contractor shall be responsible for providing all utility service connection conduit, trenching work, trench backfill work, and pullboxes from the connection point denoted by the Utility Service to the new Meter/Main Location.
  2. The Contractor shall field verify the location for underground utility service conduit runs and pullboxes with PG&E prior to installation.
- B. Service Conductors
1. The contractor will provide and install secondary conductors.
- C. Service Disconnect
1. Install and ground in accordance with NEC and as shown.
- D. Meter Socket
1. Install where shown.
- E. Meter
1. Install where shown.

**\*\*END OF SECTION\*\***

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# SECTION 16450 GROUNDING

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This section provides specifications for grounding electrical equipment and structures in a wastewater facility.
- B. Type: The equipment and material supplied under this section shall include ground rods, electrodes, conductors, and ground wires, to make a complete ground system.

### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
IEEE C2	National Electrical Safety Code
NFPA 70	National Electrical Code

### 1.03 Submittals

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010.

### 1.04 Quality Assurance

- A. Performance and Design Requirements: The grounding system shall bond together and effectively ground all exposed non-energized metal surfaces containing energized parts, devices or conductors, all building steel, all metallic electrical raceways and the neutrals of all transformers.
- B. Inspection: All ground connection shall be inspected by the Owner's Representative prior to backfill or placing of the concrete

### 1.05 Project / Site Conditions

- A. All materials used in connection with the grounding system will be installed in a water facility and may be subjected to dust, moisture, and corrosive atmospheres. Temperatures are expected to range from 10 degrees F and 115 degrees F. Relative humidity is expected to range from 10 percent to 100 percent.

## PART 2 - PRODUCTS

### 2.01 Equipment and Materials

- A. Ground Rods: Ground rods shall be one piece, 3/4-inch in diameter by 10 feet in length and shall be copper clad steel. The copper exterior shall be molten welded to the steel core. The rod heads shall be chamfered to prevent mushrooming during driving.
- B. Ground Wires: Ground wires shall be bare copper wires with Class B stranding. Size shall be as shown.
- C. Connections

1. All ground connections below grade for copper shall be made by the exothermic weld process. They shall be Cadweld, Thermoweld, or equal, made with Cadweld, Thermoweld, or equal, molds and clamps. All connections in the ground wells shall be made with a bolted ground clamp and shall be Copperweld Type "AB" with hex head set screw, Weaver Type W, or equal.
  2. All connections above grade to equipment ground buses and flat copper bars shall have a 2 bolt pad and shall be bolted with nonferrous hexagon head bolts and nuts with spring lock washers. They shall be Burndy Type "QA-B," Thomas & Betts Lock-Tite, or equal. All connections to motor shall be as shown.
  3. Connections to miscellaneous boxes, cabinets, panels, etc., shall be Burndy type "KC" servitposts, Thomas & Betts split bolt connector, or equal.
- D. The utility service entrance switchboard ground bus shall be tied to an area ground grid consisting of a ground ring with ground rods as shown on the contract drawings.
- E. The grounding system shall be as shown and as required by codes and regulations and shall include the following as applicable:
1. Metallic conduits supplemented with a ground wire installed in the conduit for all circuits except control circuits.
  2. An equipment grounding conductor installed in all nonmetallic conduit carrying power to any equipment.
- F. All ground conductors entering handholes, manholes, pull boxes, terminal boxes, or any other enclosure shall be bonded together and shall be bonded to the enclosure if it is metallic and to all metallic raceways within or terminating at the enclosure. An insulated grounding bushing shall be installed with a code size equipment grounding conductor bonded to the equipment frame for all conduits terminating under an enclosure containing no metal floor plate, or at sheet metal panels which are not fastened to the equipment frame solidly enough to provide an effective ground connection. This will commonly be the case with switchgear, switchboards and MCCs.
- G. Cable shielding, metallic conduits, wireways, metal enclosure of bus ways, cable boxes, electrical equipment housings, and all noncurrent-carrying metallic parts of the installation shall be grounded. The conduit system shall be used for equipment and enclosure grounding but not as a system ground conductor. A code sized green insulated copper grounding conductor shall be included in all nonmetallic and flexible conduits.
- H. System neutral conductors shall be grounded at the point of service ahead of the main disconnect to a grounding electrode and to a domestic cold water main as required by code. Transformer neutral shall be grounded from the neutral bushing and solidly grounded to earth. If metallic domestic water system is greater than 100 feet remote, furnish a system ground conductor in conduit to the established system grounding electrode.
- I. All conduit stub-ups shall be grounded, and where multiple stub-ups are made within an equipment enclosure, such as a service pedestal, they shall be equipped with grounding bushings and bonded together and to the enclosure and the enclosure ground bus.
- J. All services and feeder runs (and branch circuit wiring excluding light circuits) in nonmetallic or flexible conduit shall carry one green THWN/XHHW insulated code sized ground conductor per conduit.
- K. Bonding devices, fittings, or jumpers shall be provided at expansion fittings, isolation sections, or wherever continuity of ground is broken.

## **2.02 Fabrication**

### **A. Grounding Techniques**

1. The grounding electrode shall consist of a combination of the following systems as required to accomplish a resistance to ground not to exceed 5 ohms.
  - a. The utility service entrance switchboard ground bus shall be tied to an area ground grid consisting of a ground ring with ground rods as shown on the contract drawings.
  - b. Bare Wire under Foundations
    - 1) The preferred method shall be a 20-foot length of bare No. 4/0 copper wire extended its full length below ground level and embedded along the bottom of the concrete foundation footing which is in direct contact with the earth and supported in such a manner that it cannot be less than 3 inches from the bottom or side of the concrete when the foundation concrete is poured. A loop at the approximate center of this grounding electrode shall be brought out at the top of the foundation and a No. 4/0 copper ground conductor shall be connected to this loop with a pressure-type solderless connector and extended to the service equipment and to the metallic cold water system and properly connected thereto.

## **PART 3 - EXECUTION**

### **3.01 Examination:**

- A. The existing grounding system shall be evaluated and tested by the contractor. Where deemed acceptable, the existing grounding system components may be used to meet criteria required by this specification where approved in writing by the Engineer. As a minimum, the existing grounding system shall be connected with the new grounding system components required by this specification.

### **3.02 Installation**

- A. All grounding system components shall be installed in accordance with the contract drawings, NEC, and the manufacturer's recommendations and instructions.
- B. Provide a separate grounding conductor in each raceway, securely grounded to equipment at each end of the raceway.
- C. Contractor shall not cover or conceal any ground connections until the Owner's Representative or Engineer has established that every grounding connection conforms to the Contract Drawings and Specifications. Contractor shall provide a form to sign off each grounding connection and shall obtain signature from either the Owner's Representative or the Engineer.
- D. Electrical Equipment Grounding
  1. Metal conduits shall be bonded together to the enclosure grounding bus.
  2. Lightning arresters or suppressors shall be directly connected to the ground system using copper conductors sized in accordance with NEC requirements.
  3. The secondary neutrals of transformers shall be directly connected to the ground system using copper conductors sized as per NEC or as indicated on the contract drawings.
  4. All motors shall be grounded by bonding the grounding conductor within the raceway to the motor frame. Motors as shown on the contract drawings shall also have a supplemental grounding conductor bonded to the ground grid in the immediate area of the motor.
- E. Each panelboard shall have a ground bus that is secured to the interior of the enclosure. The bus shall be equal to panelboard neutral bus amp rating and shall have adequate lug quantity of lugs. No more than two grounding conductors shall be installed per lug.

### **3.03 Field Quality Control**

#### **A. Performance Tests**

1. The existing and new grounding system components shall be tested per this specification section.
2. The Contractor shall test each ground rod, ground mat and water pipe, structure or other major system grounding connection to determine the ground resistance. The grounding check shall be made by the "fall of potential" method utilizing a commercial ground test instrument such as the Biddle Model 593 "megger" ground check or the Associated Research Vibroground Model 225, or equal. A plot of ground resistance readings for each isolated ground rod or ground mat shall be submitted to the Resident Engineer. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test, and the measurements shall be made at 10-foot intervals beginning 15 feet from the test electrode and ending 75 feet from it, all in direct line between the ground rod or center of grid and the current reference electrode.
3. Any grounding system that shows greater than 5 ohms resistance for the flat portion of the plotted data shall be considered inadequately grounded. The Contractor shall add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurements meet the 5 ohms requirement. Use of salts, water or compounds to attain the specified ground resistance is forbidden.

### **3.04 Adjusting / Cleaning / Protection**

- A. At no additional expense to the Owner, provide any necessary work to correct improper installations.

**\*\*END OF SECTION\*\***

# SECTION 16500 LIGHTING FIXTURES & ACCESSORIES

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This section provides specifications for all lighting fixtures including refractors, reflectors, ballast, fixture hangers, lighting poles and lamps. Furnish all labor, materials, equipment and incidentals required and install complete ready for operation and field test the interior and exterior lighting system as shown on the Drawings and/or specified herein.
- B. Type: The lighting fixtures shall be units specified in the lighting schedules. Lamps of the sizes specified shall be furnished for all fixtures.

### 1.02 References

- A. All work specified herein shall conform to or exceed the applicable requirements of the referenced portions of the following publications to the extent that the provisions thereof are not in conflict with other provisions of these specifications.

<u>Reference</u>	<u>Title</u>
CSA	Canadian Standards Association
CBM	Certified Ballast Manufacturer
FCC	Federal Communications Commission
IESNA	Illuminating Engineering Society of America
IEEE C62.41	Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
NEMA 250	Enclosures for Electrical Equipment (1,000 Volts Maximum)
NFPA 70	National Electrical Code
UL 595	Marine-Type Electric Lighting Fixtures
UL 924	Emergency Lighting and Power Equipment

### 1.03 Submittals

- A. Submittals shall comply with the provisions set forth in Sections 01300 and 16010. In addition, the submittals shall also contain the following data, drawings and descriptive material:
1. Shop drawings, Record Drawings and operating and maintenance manuals
  2. Include electrical ratings, dimensions, mounting, material, required clearances, terminations, wiring and connection diagrams, photometric data, ballasts, diffusers, louvers, lamps and controls.
  3. Submit manufacturer's data for each type of electronic ballast and driver
  4. Any exceptions to these specifications along with justification for each exception
  5. Large-scale polar plots providing candlepower vs. angle and foot-lamberts (brightness) vs. angle for longitudinal and transverse axis
  6. Tabular information for calculation of illumination level by the zonal cavity method

## **1.04 Quality Assurance**

### **A. Regulatory Requirements**

1. Provide luminaires acceptable to the code authority for application and location as indicated.
2. Comply with applicable ANSI standards pertaining to lamp materials, lamp ballasts and transformers, and luminaires.
3. Comply with applicable NEMA standards pertaining to lighting equipment.
4. Provide luminaires and lampholders which comply with UL standards and have been UL listed and labeled for location and use indicated.
5. Comply with NEC 410 as applicable to installation and construction of luminaires.
6. Comply with the fallout and retention requirements of UBC 52 for diffusers, baffles, louvers, etc

## **1.05 Delivery, Storage, and Handling**

### **A. Refer to Section 16010, 1.07 for requirements**

## **1.06 Project / Site Conditions**

- A. The lighting fixtures will be installed in a water facility and may be subjected to dust, moisture, and corrosive atmospheres. Temperatures are expected to range between 10 degrees F and 115 degrees F. Relative humidity would range between 10 to 100 percent. The lighting fixtures shall be suitable for installation at the locations shown and as described under Section 16010 – General Electrical Provisions.

## **1.07 Warranty**

### **A. Ballast Manufacturer's Warranty**

1. Not less than 5 years for electronic type ballasts, based on date of manufacturer embossed on ballast, current with installation date. Magnetic ballasts are not allowed for this project.
2. Warranty includes normal cost of labor for replacement of ballast.

- B. Lamp Warranty: 5 years for LED, 6 months for compact fluorescent, 12 months for fluorescent and HID lamps.

## **1.08 Maintenance**

### **A. Refer to Section 16010, 1.09 for requirements.**

## **PART 2 - PRODUCTS**

### **2.01 Equipment and Materials**

- A. Refractors and Reflectors: All glassware and plastic shall be uniform, free from defects and photometrically tested for distribution by an independent testing laboratory. Plastic diffusers shall be of new virgin acrylic plastic material. All refractors and reflectors shall be thoroughly cleaned by the Contractor immediately prior to inspection and acceptance by the Engineer.
- B. Fixture Hangers: Stems shall be 2-inch galvanized conduit or 3/8-inch galvanized all thread rods.
- C. Ballasts
1. Fluorescent fixtures shall have thermosetting compound-filled non-leak electronic ballasts rated for 120 or 277 volt service as required. Two-lamp ballasts shall be used where applicable. Ballasts for fixtures located in covered unheated areas and open areas shall be

low temperature type. Ballasts shall be Class P, protected type, high power factor and shall carry the CBM (Certified Ballast Manufacturers) and UL insignia. All ballasts shall be premium type designed for case temperature lower than the nominal UL 90 degree C requirement. Each fixture submittal shall designate the make and catalog number of ballast. Rapid start ballast sound rating shall have a sound rating of "A."

2. After installation is completed, any ballast which is judged to be excessively noisy shall be removed and replaced at no extra charge.

#### D. Ballasts – Emergency Type

1. Emergency Ballast shall be in accordance with UL 924.
2. The Emergency Ballast System shall consist of a nickel cadmium batter, battery charger, and electronic circuitry in a metal case plus the ac ballast.
3. Provide a solid state charging indicator monitoring light and double-pole test switch.
4. For linear fluorescent lamps, the emergency ballast shall be capable of operating one or two fluorescent lamps for a period of 90 minutes with a total output of 1,100 lumens maximum.
5. For compact fluorescent lamps rated up to 13 watts, emergency ballast shall be capable of operating one lamp for a period of 90 minutes with a total fixture output of 580 lumens minimum.
6. For compact fluorescent lamps rated above 13 watts, emergency ballast shall be capable of operating one or two lamps for a period of 90 minutes with a total fixture output of 750 lumens minimum.
7. Manufacturers:
  - a. Magne-Tek Lighting Products
  - b. The Bodine Company, Inc
  - c. Lithonia,
  - d. Or Approved equal

#### E. LED light fixtures

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
  - a. Minimum efficiency: 85% at full load.
  - b. Minimum Operating Ambient Temperature: -20° C. (-4° F.)
  - c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
  - d. Integral short circuit, open circuit, and overload protection.
  - e. Power Factor: ≥ 0.95.
  - f. Total Harmonic Distortion: ≤ 20%.
  - g. Comply with FCC 47 CFR Part 15.
4. LED modules shall include the following features unless otherwise indicated:
  - a. Comply with IES LM-79 and LM-80 requirements.
  - b. Minimum CRI 80 and color temperature 3000° K unless otherwise specified.

- c. Minimum Rated Life: 50,000 hours per IES L70.
- F. Pendant-mounted fixtures shall be supported from 360 degree swivel fixture hangers. Fixtures mounted on stems less than 12 inches long may be suspended rigidly.
- G. Lamps: Unless otherwise noted in the fixture schedule, LED lamps shall be day light white, fluorescent lamps shall be standard warm white and mercury vapor lamps shall be deluxe white. Lamps shall be new when installed, and all burned out lamps shall be replaced prior to acceptance of the work.
- H. Lighting Poles
  - 1. Provide exterior light poles with concrete bases and which are structurally supportive of pole under design loading.
  - 2. Provide exterior poles clean and scratch free with base bolt covers to match pole and luminaire finish.
  - 3. Provide poles and pole bases rated for a minimum of 100 MPH, unless otherwise noted, wind EPA loading for the quantity and type of luminaire it supports with a 1.3 gust factor

## **2.02 Components and Accessories**

### **A. Lighting Control**

- 1. Type of lighting control and sensors in each area or zone is shown on the drawings. Provide lighting control systems for each space as shown on the Contract Drawings with equipment as specified in this section.
- 2. General: Drawings will indicate type of control required for each space. Contractor shall work with lighting control manufacturer representative to provide equipment necessary to meet intent of control shown on the Contract Drawings. Contractor shall submit site plans, floor plans and wiring diagrams for approval by engineer as part of the submittal process.
- 3. Time Switch:
  - a. Digital electronic time switch shall have a Form C dry contact, output rated for 6 amps at 120 VAC or 10 amps at 277 VAC. Time switches shall have the minimum following set of features:
    - 1) Time out setting ranging from 5 minutes to 12 hours
    - 2) 5-minute time resolution up to 1 hours, then 15-minute time resolution up to 12 hours
    - 3) Visual warning feature that flashes lights at 5 minutes and 1 minute prior to time-out
    - 4) Audible warning feature that beeps every 5 seconds at 1 minute prior to time-out
    - 5) Compatible with electronic ballasts and motor loads
    - 6) No minimum load requirement
    - 7) Manufacturers:
      - a) Watt Stopper, Inc. TS-400
      - b) Or Approved Equal
- 4. Exterior Photocell:
  - a. Automatic OFF switching photo control
  - b. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.

- c. Setting: OFF at dawn.
  - d. Time delay feature to prevent false switching
  - e. Field adjustable to control operating levels
  - f. Manufacturers:
    - 1) Tork
    - 2) Paragon Electric Company
    - 3) Or Approved Equal
5. Occupancy Sensor
- a. General:
    - 1) Accommodate loads from 0 to 800 watts at 120 volts; 0 to 1,200 watts at 277 volts.
    - 2) Bi-level wall sensors shall accommodate up to two loads from 0 to 800 watts at 120 volts; 0 to 1,200 watts at 277 volts, for each load.
    - 3) Utilize passive infrared, ultrasonic, or dual technology, as indicated on the Contract Drawings or as recommended by the manufacturer for specific areas to be covered.
    - 4) Provide selectable “walk through” mode that turns lights off 3 minutes after the room is initially occupied if no motion is detected after the first 30 seconds.
    - 5) Capable of operating normally with any electronic ballast and PL lamp systems
    - 6) Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to cycling of air conditioner or heating fans.
    - 7) Readily accessible, user adjustable controls for time delay and sensitivity
    - 8) In event of failure, manual bypass feature shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
    - 9) Units shall have an extra Form C contact [for interface with building system]. Units shall be designed to be mountable in standard electrical box.
    - 10) Units shall have capability of being ordered with integral power pack.
    - 11) Fail-safe feature
    - 12) UL Listed.
  - b. Passive Infrared: Passive infrared sensors shall have a multiple segmented lens, in a multiple-tier configuration, with grooves to eliminate dust and residue build-up.
  - c. Ultrasonic:
    - 1) Utilize Doppler Principle and high frequency ultrasound to detect occupancy
    - 2) No audio technology units will be accepted
  - d. Dual Technology Units: Unit shall utilize both passive infrared and ultrasonic technologies and be easily programmed to accommodate different environmental and architectural conditions.
  - e. Wall Switch Sensors:
    - 1) 180-degree coverage

- 2) Capable of detection of motion at desk top level up to 300 square feet and gross motion up to 1,000 square feet
  - 3) Can utilize passive infrared, ultrasonic, or dual technology
- f. Ceiling Mounted Units:
- 1) 360-degree coverage
  - 2) Unit must detect up to 1,500 square feet with no blind spots
  - 3) Can utilize passive infrared, ultrasonic, or dual technology
  - 4) Compatible with momentary contact manual switch or pushbutton
- g. Low Voltage Power Pack/Control Units
- 1) Able to mount through a ½-inch knock-out in a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Transformer shall provide power to a minimum of two sensors.
  - 2) UL 2043 plenum rated so that power packs do not need to be installed in junction boxes, but can be directly installed in plenum.
  - 3) Relay contacts shall have ratings of 20A, 120 VAC electronic ballast.
- h. Corrosive Location Line Voltage Sensors:
- 1) The installing contractor shall install one or more sensors with PIR coverage areas that cover the entire space and all entrance points. Exact placement and quantity required shall be per manufacturer's best practice recommendations.
  - 2) Sensors shall utilize a digital PIR detector (dual element pyro-electric detector) component, so as to provide a high degree of RF immunity.
  - 3) Line and load wire connections shall be interchangeable, such that installer cannot make an improper connection to a line/load in a manner that will cause malfunction or damage to the sensor.
  - 4) Multiple sensors controlling the same load shall be wired in parallel.
  - 5) Sensors shall be capable of switching both 120 VAC and 277 VAC and run off of 50/60 Hz power. A version capable of switching 347 VAC shall also be available. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load.
  - 6) Wall mounted sensors must be installed at 7 to 8 feet above the floor. Single and two circuit units shall be available.
  - 7) High bay sensors controlling HID Bi-Level must incorporate a "Start to High" timer on initial power up to provide full light output for up to 20 minutes to prevent shortened lamp life.
  - 8) Sensors shall have test mode that temporarily shortens/disable all time delays (e.g., minimum on, occupancy, photocell transition, dimming rates) such that an installer can quickly test operation of sensor. Test mode shall time out and return sensor to normal operation should the installer forget to disable test mode after installation.
  - 9) Sensors shall have optional features for on/off photocell control, automatic dimming control photocell, high/low occupancy based dimming, and usage in low temperature/high humidity environments.
  - 10) Sensors shall be the following Sensor Switch model numbers.

- a) **SBR 10** (Extended range Range 360°, PIR, Ceiling Mount)
- i. Wiring: Control wiring between sensors and control units shall be Class 2, 14-AWG, stranded, UL Classified, PVC insulated or Teflon jacketed cable approved for use in plenums, where applicable.
- j. Manufacturers:
  - 1) Watt Stopper, Inc.
  - 2) Unenco, Inc.
  - 3) Sensorswitch, Inc.
  - 4) Or approved equal

## **PART 3 - EXECUTION**

### **3.01 Examination**

- A. Verification of Conditions: Verify ceiling construction, recessing depth and other construction details prior to release of luminaire for shipment. Refer cases of uncertain applicability to the Architect for resolution prior to release of luminaires for shipment.

### **3.02 Installation**

- A. Provide all lighting indicated on the Drawings with a luminaire of the type designated and appropriate for the location. Where outlet symbols appear on the Drawings without a type designation provide a luminaire the same as those used in similar or like locations.
- B. Provide Owner with a minimum of two lamps or 20 percent of total of each type and wattage, whichever is greater.
- C. Install luminaire of types indicated where shown and at indicated heights; in accordance with manufacturer's written instructions and with recognized industry practices; to ensure that luminaires comply with requirements and serve intended purposes.
- D. Align, mount and level the luminaires uniformly. Use ball hangers for suspended stem mounted luminaires.
- E. Avoid interference with and provide clearance for equipment. Where the indicated locations for the luminaires conflict with the locations for equipment, change the locations for the luminaire by the minimum distance necessary as directed by the Architect.
- F. Suspended Luminaires: Mounting heights indicate the clearances between the bottom of the luminaire and the finished floors.
- G. Install lamps in all luminaries.
- H. Luminaire Supports
  - 1. Support Luminaires: Anchor supports to the structural slab or to structural members within a partition, or above a suspended ceiling.
  - 2. Provide mounting brackets and/or structural mounting support for wall-mounted fixtures.
    - a. Do not support luminaire from conduit system.
    - b. Do not support luminaire from outlet boxes.
  - 3. Maintain the luminaire positions after cleaning and relamping.
  - 4. Support the luminaires without causing the ceiling or partition to deflect.

5. Provide concrete footings for pole mounted lighting units and bollard lights at locations shown on site plan Drawings. Provide concrete footings as shown on Drawings or as recommended by the manufacturer if not shown on the Drawings. Minimum base height in automobile areas is 30 inches. Install luminaire poles plumb and straight.
6. Provide recessed fluorescent luminaires with two support wires as outlined in the UBC.

#### I. Wiring

1. Recessed luminaires to be installed using flexible metallic conduit with luminaire conductors to the branch circuit conductors in a nearby accessible junction box over the ceiling. Junction box fastened to a building structural member within 6 feet of the luminaire.
2. Install luminaires for lift-out and removal from ceiling pattern without disconnecting conductors or defacing the ceiling materials.
3. Flexible connections where permitted to exposed luminaires; neat and straight, without excess slack, attached to the support device.
4. Install junction box, flexible conduit and high temperature insulated conductors for through wiring of recessed luminaires.

#### J. Ballasts

1. Install in accordance with manufacturer's recommendations.
2. Utilize all ballast mounting holes to fasten securely within luminaire.
3. Replace noisy or defective ballasts.

#### K. Emergency Ballast

1. Install battery, charger, and electronic circuitry metal case inside fluorescent fixture housing adjacent to ac ballast.
2. Install monitoring light and double-pole switch adjacent to light fixture.
3. Wire in accordance with manufacturer's wiring diagrams.

#### L. Lighting Control

1. Outdoor Luminaires: Toggle switch lighting ON and OFF, photocell off
2. Occupancy Sensors: Locate and aim sensors in correct location required for complete and proper volumetric coverage within range of coverage of controlled areas per manufacturer's recommendation.
  - a. Rooms shall have 90 to 100 percent coverage to completely cover controlled area to accommodate all occupancy habits of single or multiple occupants at any location within rooms.
  - b. Location and quantities of sensors shown on Drawings are not final. Drawings indicate what type of control and sensing is required in each area, space or room. Contractor shall coordinate with lighting control system provider(s) to install required quantity of control and sensors in order to provide a complete and functional lighting control system

### 3.03 Field Quality Control

#### A. Occupancy Sensors and Lighting Control Systems:

1. Furnish manufacturer's representative at Job Site to inspect installation, test units and put into service.

2. Provide, at Owner's facility, training necessary to familiarize Owner's personnel with operation, use, programming, adjustment, and problem solving diagnosis of occupancy sensing devices and lighting control systems

### **3.04 Adjusting / Cleaning / Protection**

#### **A. Adjusting and Cleaning**

1. Focus and adjust the floodlights, spotlights and other adjustable luminaires, with the Engineer, at such time of day or night as required.
2. Align luminaires and clean lenses and diffusers at completion of Work. For cleaning, use antistatic cleaners only.
3. Remove labels and markings, except UL listing mark.
4. Clean paint splatters, dirt, fingerprints, and debris from installed luminaires.
5. Touch up damaged luminaire and poles finish at completion of work with matching paint order from manufacturer.
6. Replace all incandescent lamps operated during construction and all failed LED, fluorescent, metal halide, mercury vapor and high pressure sodium lamps with new lamps prior to final acceptance by Owner.
  - a. Re-lamping is to be done at end of Project.

- B. All fixtures used during construction shall be re-lamped one week prior to final inspection of the work.

**\*\*END OF SECTION\*\***

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## SECTION 17010 GENERAL REQUIREMENTS, INSTRUMENTATION

### PART 1 - GENERAL

#### 1.01 Summary:

- A. Scope: General requirements for Instrumentation and Control System (ICS) design, procurement, delivery, and implementation as shown on the Contract Drawings (Drawings) and as specified in these Specifications.
- B. The contactor shall retain the service of a System Integrator. The Owner shall obtain the service of an Applications Programmer who will be part of the construction management team.
- C. The System Integrator will purchase, assemble, configure, prepare submittal material and prepare Operations and Maintenance Manuals all of the components that make up the ICS. In addition, the System Integrator will purchase, assemble, configure, prepare submittal material and prepare Operation and Maintenance Manuals for the Main Switchboard, Motor Control Center, and Pump Station Control Panel. The System Integrator shall conduct associated Factory Acceptance Testing and Site Acceptance Testing noted.
- D. The Application Programmer work is limited to programming and configuration, and associated startup and testing services of the PLC, Operator Interface, and SCADA. All other work in this section is to be performed by a qualified Systems Integrator
- E. The following System Integrators have been pre-approved and pre-qualified for this project:
  - 1. Tesco Controls, Sacramento, CA
  - 2. Telstar, Sacramento, CA
  - 3. Krug-Bixby-Long Associates, Hayward, CA.
  - 4. or Approved System Integrator prior to Bid Opening and as noted by Addendum.
- F. Approved System Integrator Prior to Bid Opening:
  - 1. Prior to Bid Opening, the Contractor may submit the qualifications of a System Integrator not listed as pre-approved and pre-qualified for consideration by the Owner's Representative. If the Owner's Representative accepts the System Integrators qualifications and issues an addendum prior to bid, then the System Integrator is considered acceptable for the project. The qualifications must be submitted 10 days prior to Bid Opening to be considered.
  - 2. The Contactor may submit qualifications package for a System Integrator for approval by the District. Any qualifications package that does not include all of the following information will automatically be considered unresponsive and will be rejected. Only one submission per System Integrator shall be allowed.
  - 3. To be considered the System Integrator must meet the following pre-conditions.
    - a. System Integrator Facility is located within 200 miles of the project site.
    - b. System Integrator is certified by Control System Integrators Association (CSIA)
  - 4. The qualifications package shall include the following:
    - a. An introduction letter including the following:
      - 1) Actual distance from project site not to exceed 200 miles
      - 2) Copy of CSIA certification

3) System Integrator Company Information

- a) Company Name
- b) Company Address
- c) Company Internet Website
- d) Company Telephone Number
- e) Company Fax Number
- f) Project Contact Name, E-mail address and telephone number

4) Number of years in business – the system integrator shall have been in business performing control, integration, and configuration and programming activities for at least 15 years.

b. Provide the names and resumes of the System Integrator's programmer or programming team that have a minimum of 5 years experience in the design, coordination, and supply of computer-based monitoring, control and data acquisitions systems.

- 1) Shall have programming and configuration experience with Allen- Bradley
- 2) The submitted and approved programmer(s) shall provide all programming associated with this project. The programmers assigned to perform the scope outlined in this contract may not be replaced without submitting additional qualified resumes and obtaining written approval from the Owner.

G. System Integrator must be pre-approved by the Engineer in order to submit a bid for this project. Any bid listing a System Integrator that has not been pre-approved will be automatically disqualified.

H. Interpretation of Drawings

- 1. General: Any error or omissions of details in either the Drawings or Specifications shall not relieve the System Integrator from correctly installing all materials necessary for a complete and operating ICS.
- 2. Site Verification: The System Integrator shall inspect the project site and verify all measurements and conditions and shall be responsible for the correctness of final installation. No extra compensation will be allowed because of differences between work shown on the Drawings and measurements at the site.
- 3. Drawings: The Instrumentation Drawings are diagrammatic, but shall be followed as closely as existing conditions and work of OTHERS will permit. All deviations from the Drawings required to make the work conform to structures as constructed, and to the work of OTHERS, shall be made at the System Integrator's own expense.
- 4. Coordination: The System Integrator shall examine the architectural, structural, mechanical and manufacturer's drawings for all equipment to coordinate and determine the exact routing and final terminations of all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.
- 5. Accessibility: The Drawings do not show the exact locations of equipment. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The Owner reserves the right to require minor changes in location of outlets or equipment, prior to roughing in, without incurring any additional costs or charges.

I. Manufacturer's Directions

- 1. Manufacturer's directions shall be followed in all cases where manufacturers furnish instructions covering points not shown on the Drawings or specified in these Specifications.

## J. Inspection

1. The System Integrator and Contractor shall cooperate with the Construction Manager and shall provide assistance at all times for the inspection of the instrumentation work. Remove covers, or perform any reasonable work, which in the opinion of the Construction Manager will be necessary to determine the quality or adequacy of the work.
2. If any material does not conform to these Specifications the Contractor shall, within three (3) days after being notified by the Construction Manager, remove the materials from the premises.
3. Work shall not be closed in or covered before inspection and approval by the Construction Manager. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor.

## K. Supervision and Workmanship

1. The Contractor shall employ a competent instrumentation foreman on the job throughout the entire period of construction to see that his work is carried on without delay and completed as rapidly as possible.
2. Before the start of construction and in conjunction with the schedule of others, the Instrumentation Sub-Contractor shall furnish to the General Contractor a tentative construction schedule showing the order of the work, the process control panel shop drawings submittal dates and the anticipated delivery dates of all instrumentation equipment.

## L. Cooperative Work with Others

1. The System Integrator and Contractor shall cooperate with others, with due regard to their work, towards promotion of rapid completion of project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provision in time by System Integrator or the Contractor, then it shall bear expense of such changes as necessary to be made in work of others.
2. Labor and materials, including templates, sleeves, anchors, concrete inserts and the like shall be furnished in ample quantities at such times as necessary to ensure uninterrupted progress of work.
3. The Contractor shall cease work at any particular point temporarily and transfer its operations to such points or execute such portions of work as directed, when in the judgment of the Construction Manager it is necessary to do so.

## M. Quality of Materials

1. All instrumentation components used on this project shall be new and free from defects.
2. All instrumentation components used on this project shall conform where applicable, to the Codes and Standards in Section 1.02, References.
3. Each type of material shall be of the same manufacturer and quality throughout the work.

## N. Substitutions

1. No substitutions shall be allowed unless specifically noted as "or equal" or as "or approved equal." Specific brand names and catalog numbers are used to describe materials in order to establish standards of performance and quality.
2. The decision of the Engineer or Construction Manager shall govern as to what is equal to the item specified. Equality will be judged on the basis of the following:
  - a. Conformance to description or performance required
  - b. Equality in quality

- c. Comparable in appearance and artistic effect where these are considerations
  - d. Comparable operation, maintenance and performance
  - e. Equal in longevity and service under conditions of climate and usage
  - f. Conformance with space allocations and requirements for operations from mechanical or electrical services provided without necessitating changes in details and construction or related work
3. If the Engineer considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Engineer.
  4. Any material, article, or method judged by the Engineer equal to that specified will be approved, provided the Contractor submit a single written request, in triplicate, to the Construction Manager, within 30 days after contract award, with the following information for each item:
    - a. Complete data substantiating compliance of proposed substitution with Contract Documents.
    - b. Product Identification including trade or brand name including type, model, style, and/or catalog number
    - c. Manufacturer's literature marked to indicate specific model, type, size, and options to be considered
    - d. Size or capacity rating
    - e. Names and addresses of a minimum of three (3) references for similar installations to this Contract
    - f. Manufacturers' statements that proposed products are equal or superior in all respects to that specified.
  5. The System Integrator assumes full responsibility for including complete and correct data in its request for substitution. The System Integrator shall also attach complete referenced diagrams and technical data sheets for the Engineer's review and determination of equality or suitability of any substitution item. Only one such request may be submitted. The Engineer's rejection of any substitute shall automatically require the System Integrator furnish the specified item without further discussion or delay.

## 1.02 References

- A. General: The work shall comply with the most recent Codes and Standards as published at the date of the Contract and as listed in the Specifications.

<u>Reference</u>	<u>Title</u>
NFPA 70	National Electrical Code – Latest Edition
NFPA 101	Life Safety Code - Latest Edition
UBC	Uniform Building Code - Latest Edition
ANSI	American National Standard Institute
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers

<u>Reference</u>	<u>Title</u>
IEEE	Institute of Electrical and Electronic Engineers
ISA	International Society of Automation
JIC	Joint Industrial Council
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
SAMA	Scientific Apparatus Makers Association
UL	Underwriters' Laboratories, Inc
EIA	Electronic Industries Association
	Local Mechanical and Electrical Codes
	Any additional codes effective at the job site

- B. Additional Requirements: The System Integrator shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in the Specifications or shown on the Drawings.
- C. Permit Requirements: The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included in these Specifications. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the Construction Manager. When these Specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the Specifications shall take precedence.

### **1.03 System Description**

- A. General: Furnish all necessary labor, materials, equipment and incidentals required to install a complete and operational Instrumentation and Control System in accordance to the intent of these Specifications and Drawings.
- B. Itemized Work: The following list shall be considered major work items, but not an inclusive and complete description of the scope of work. The Drawings in conjunction with the Specifications shall be used to determine the complete ICS work. The general scope of work includes the furnishing, installing, programming, testing, and commissioning of the following items:
  1. Instrumentation and Control System. This Item includes:
    - a. Programming and configuration of the new Programmable Logic Control (PLC) systems, Industrial computer, and Communication system.
    - b. Programming and configuration of the new power monitor in the motor control center.
  2. Coordination with vendors or subcontractors (others) to interface with the control systems provided by others. This Item includes all interconnection wiring required for interfacing with such control systems to the pump station PLC as shown on the contract drawing P&IDs.
  3. All supports, bases, anchors, sleeves, hangers, conduit seals, and the like.
  4. Shop Drawings and Operation and Maintenance (O&M) manuals.

5. Control Panels including all control components required for proper operation of the control system.
6. All power supplies, transformers, pushbuttons, pilot lights and selector switches.
7. Instrumentation system including but not limited to level transmitters, level switches, pressure transmitters, pressure switches, pressure gauges, flow meters, flow switches, smoke detectors and intrusion switches.
8. Interconnection wiring diagrams.
9. Factory Acceptance Tests
10. Site Acceptance Tests
11. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions specified elsewhere in these Specifications.
12. Throughout this Contract, follow manufacturer's recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in indoor locations that are clean and dry. Items that are subject to corrosion under damp conditions and items containing electrical insulation, such as control panels, conductors, instrumentation and controls, shall be stored in clean, dry, indoor, heated locations. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in control panels, and instrumentation which do not have space heaters.
13. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. Energize all space heaters furnished with equipment

#### **1.04 Submittals**

- A. General: Submittals for all ICS equipment shall be prepared and submitted in accordance to Special Provisions and as described herein.
- B. Requirements: The submittal package for each individual equipment or groups of related equipment shall include all the required data and information and shall be complete. As a condition to the review of submittals required under these specifications, the System Integrator shall furnish the manufacturer's statement for the equipment accepting the unit responsibility. The purpose of this provision is to ensure compatibility of all components specified under the specific Technical Specifications; and to provide sole source responsibility for system performance and maintenance. Notwithstanding these provisions, however, the System Integrator is not relieved of his responsibility for the indicated portions of the work. The following submittal data shall be provided for each item of equipment. Additional data specific to individual equipment specified under individual Specifications shall be submitted in addition to the following.
- C. Contract Drawings: The Drawings are generally diagrammatic unless detailed or dimensioned. Structural conditions, physical interference and locations of terminations of equipment shall govern the exact locations and routing of wiring, conduit and pipe. The Contractor and System Integrator shall examine the architectural, structural, mechanical, electrical and instrumentation plans and shop drawings for the equipment to determine the exact routing and final terminations of conduit, cables and pipes. Conduits and pipes shall be stubbed as near as possible to equipment terminals.
- D. Deviations from Specifications: Should the System Integrator's proposed system specifications deviate from these Specifications, such deviation shall be documented and submitted to the Engineer for approval. All deviations shall be stated on the submittal transmittal sheet.
- E. Organization and Binding of Submittals: The initial and subsequent submittals of drawings and data for review shall be organized and bound so that eventually they may be used as guides for

preparing the required maintenance manuals. The submittal shall be organized in three (3) parts, not including preliminary administrative material such as table of contents, as follows:

1. Part 1 shall consist of a series of sections, one for each process control system. Each section shall be divided by a tab and shall include the material specified below.
2. Part 2 shall include outline dimension drawings for panels, cabinets, consoles and the like, as specified below.
3. Part 3 shall include data on miscellaneous parts and accessories not included in Part 1.

F. Data Sheets: Data sheets shall be in a standardized format and shall include the following:

1. Components name used herein and on the drawings,
2. Manufacturer's model number or other product designation,
3. Project tag number,
4. System of which the component is a part,
5. Location or assembly at which the component is to be installed,
6. Input and output characteristics,
7. Scale range and units (if any) and multiplier (if any),
8. Requirements for electric supply (if any),
9. Requirements for air supply (if any),
10. Materials of component parts to be in contact with, or otherwise exposed to, process media,
11. Reference to manufacturer's descriptive technical bulletin or brochure,
12. References to other features so that all specified features are stated on the data sheet,
13. Following each data sheet, a technical product bulletin, or brochure (or clear photocopy thereof) shall be inserted; this shall provide amplifying technical information on the construction, characteristics, and capabilities of the component described in the related data sheet. Elaborate and extensive technical details shall not accompany these bulletins. All bulletins shall be of the most recent issue,
14. Part 2 of the submittal shall include outline and dimension drawings for all enclosed assemblies including cabinets, panels, consoles and the like. These drawings shall show the arrangements of panel-mounted and internally mounted components to scale and shall include enough details to clearly establish the style and overall appearance of each assembly, and
15. Part 3 of the submittal shall consist of a series of data sheets for accessory components together with supporting catalog pages or bulletins (or clear photocopies thereof). These shall be arranged in a logical sequence and shall cover such items as:
  - a. Control circuit devices, components and wiring
  - b. Pneumatic components, fittings and tubing
16. Operation and Maintenance Manuals
  - a. General: The System Integrator shall provide Operation and Maintenance (O&M) manuals in accordance with Section 01300.
  - b. Content: A set of manuals shall include all the drawings and required data and shall be organized and bound as specified for the review submittals. These drawings and data shall be supplemented with installation, connection, operation, troubleshooting, maintenance and overhaul instructions in complete detail. This shall provide the OWNER with comprehensive information on all systems and components to enable operation, service,

maintenance and repair. Exploded or other detailed views of all instruments, assemblies and accessory components shall be included together with complete parts lists and ordering instructions.

- c. Format: In addition to the requirements set forth elsewhere, the O&M manuals shall consist of at least the following:
- 1) Table of contents,
  - 2) Manufacturer's or its representative's contact information,
  - 3) Equipment complete model number for ordering,
  - 4) Spare parts with model numbers,
  - 5) Special tools with model numbers,
  - 6) System block and schematic diagrams,
  - 7) Component schematic diagrams, and
  - 8) Written step-by-step operating, troubleshooting and calibrating instructions for each of the systems and each of the components of each system

## **1.05 Quality Assurance**

### **A. Performance and Design Requirements**

1. **Manufacturer's Qualifications:** The equipment furnished under this division shall be the product of firms regularly engaged in the design and manufacture of the type of item specified, possessing the required technical competence, skill, resources and ability to complete the work specified herein with the requisite degree of quality in a timely and efficient manner. The Contractor shall be prepared to adequately document the qualifications of the manufacturers nominated to provide the equipment specified under this division. All documentation shall be submitted to the Owner's Representative prior to design fabrication and shipment of any component specified herein. Nothing contained within these provisions shall be construed as relieving the Contractor of his responsibility for any portion of the work covered by this Section.
2. **Arrangement:** The drawings are generally diagrammatic and the location of instruments and control panels are approximate unless detailed or dimensioned. The exact locations and routing of cables and conduits shall be governed by structural conditions, physical interferences and the location of electrical terminations on equipment.
3. The Contractor shall examine the structural and mechanical plans and shop drawings for the various equipment to determine exact routings and final terminations for all raceways and cables. Conduits shall be stubbed up as near as possible to field instruments and shall be within the concrete base for the equipment or a separate concrete curb.
4. All conduit, instruments and control panels shall be installed in such a manner as to avoid all obstructions and to preserve head room and keep openings and passageways clear. Control Panels, metering, transmitters and similar items shall be located within finished rooms, as shown. Where the Drawings do not indicate exact locations, the Contractor shall submit proposed locations to the Engineer for review. Where equipment is installed without instruction and must be moved, it shall be moved without additional cost to the Owner.
5. All work, including installation, connection, calibration, testing, and adjustment, shall be accomplished by qualified, experienced personnel working under continuous, competent supervision. The completed installation shall display competent work, reflecting adherence to prevailing industrial standards and methods.

6. Allowance has been made in the design for the number of raceways, cables and conductors considered adequate for feeding the various instruments and control panels. These circuits and diagrams are based on available data pertaining to the particular design of equipment and portray the systems, which the owner has chosen to effect the required operation and level of control. Equipment provided by the Contractor (even though of the make and model specified) may differ in detail, arrangement, or connections from that shown. If the Contractor uses equipment which differs from the equipment shown in major aspects and requires modifications to power, control or other electrical service, the Owner's acceptance of the equipment will be based upon the Contractor providing the modifications required, and they shall be of the same quality as shown and shall be provided at no additional cost to the Owner.
7. Protection of Equipment and Materials: The Contractor shall provide adequate means for and shall fully protect all finished parts of the materials and equipment against damage from any cause during the progress of the work and until acceptable by the Owner's Representative.
8. All materials and equipment, both in storage and during construction, shall be covered in such a manner that no finished surfaces will be damaged, marred, or splattered with water, foam, plaster, or paint. All moving parts shall be kept clean and dry.
9. The Contractor shall replace or have refinished by the manufacturer, all damaged materials or equipment, including face plates of instruments and control panels, at no expense to the Owner.
10. Tests: The Contractor shall make all tests required by the Owner's Representative or other authorities having jurisdictions as per applicable standards. All such tests shall be performed in the presence of the Owner's Representative. The Contractor shall furnish all necessary testing equipment and pay all costs of tests, including all replacement parts and labor necessary due to damage resulting from damaged equipment or from test and correction of faulty installation. Operational testing shall be performed on all equipment furnished and/or connected in other Sections of Division 16. Electrical and all other divisions specifying electrical items including furnishing of support labor for testing.
11. Standard test reports for mass-produced equipment shall be submitted along with the shop drawing for such equipment. Test reports on testing specifically required for individual pieces of equipment shall be submitted to the Owner's Representative for review prior to final acceptance of the project.
12. Any test failure shall be corrected in a manner satisfactory to the Owner's Representative.
13. The Contractor shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in these particular specifications or shown on the drawings.
14. The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included under this Division. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the Owner's Representative. When these specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the specifications shall take precedence.

## **1.06 Delivery, Storage, and Handling**

- 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 manufacturer's recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical

insulation, such as instruments, conductors, and control panels. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in control panels which do not bare space heaters.

B. Shipment: The major equipment items listed in this provision and furnished under this contract shall be shipped in sealed, weather-tight, enclosed conveyances in a manner designed to protect the equipment against damaging stresses during transport.

C. Inspection

1. The Contractor shall cooperate with the Owner's Representative and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate machinery, or perform any reasonable work which, in the opinion of the Owner's Representative, will be necessary to determine the quality or adequacy of the work.

2. If any material does not conform to these specifications, the Contractor shall, within three days after being notified by the Owner's Representative, remove the materials from the premises.

3. Work shall not be closed in or covered before inspection and approval by the Owner's Representative. Cost of uncovering and making repairs where un-inspected work has been closed in shall be borne by the Contractor.

### **1.07 Project / Site Conditions**

A. The ICS shall be installed in a Water Pump Station which will be subjected to environmental conditions where temperatures may vary from 10 degrees F and 115 degrees F; relative humidity may vary from 10 to 100 percent; and trace quantities of moisture and dust may be present.

### **1.08 Sequencing and Scheduling**

A. Sequencing and scheduling plan shall be provided that minimizes pump station downtime. Note that the pump station must remain operational during all phases of construction. For additional requirements refer to the Special Provisions.

### **1.09 Warranty**

A. Refer to Section 17506 for requirements.

### **1.10 Maintenance**

A. Refer to Section 17506 for requirements.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

A. Refer to Division 17 specifications.

### **2.02 Equipment and Materials**

A. Refer to Section 17110.

### **2.03 Components and Accessories**

A. Refer to Section 17110.

### **2.04 Fabrication**

A. Refer to Section 17110.

## **2.05 Source Quality Control**

A. Refer to Section 17110.

## **PART 3 - EXECUTION**

### **3.01 Examination**

A. Refer to Section 17110.

### **3.02 Preparation**

A. Refer to Section 17110.

### **3.03 Installation**

A. Refer to Section 17110.

### **3.04 Field Quality Control**

A. Tests and Instrument Calibration

1. General: All tests shall be in accordance with the requirements of Sections 17510 and 17512 of these Specifications.
2. Individual Component Calibration: Each instrument and final element shall be field calibrated in accordance with the manufacturer's recommended procedure.
3. Loop Tests: Each instrument loop shall be treated as an integrated system. This test shall be designed to verify that all components within the loop operate correctly and that the loop functions correctly.
4. Notify City in writing 48 hours in advance of testing for witness by Owner's Representative.
5. Submit written report of testing results to Owner's Representative

B. System Start-Up

1. General: When all systems and components have been successfully calibrated and tested, a date for the Plant start-up involving the Owner's Representative shall be scheduled and agreed upon.
2. Procedure: The ICS shall be rechecked to verify proper operation. Final adjustments shall be made as required.
3. Report: Provide a written report to the Engineer verifying the operation of the ICS. Note any problems or concerns in this report.

C. Operator Training

1. General: Operator training shall be provided for the ICS after the System Startup has been successfully executed.
2. Format: The Plant operating personnel shall be instructed in the functions and operation of each system and shall be shown the various adjustable and set point features which may require readjustment, resetting, or checking and re-calibration by them from time to time. The O&M manuals in addition to the System Integrator's prepared materials shall be used for this training.

D. Duration: The training shall consist of a two (2) day course, a minimum of 16 hours total instruction, for up to five (5) students. This course shall be conducted at the jobsite on an agreed upon date independent of any testing or startup dates. A detailed outline of this course shall be

submitted to the ENGINEER at least 10 days in advance of the training start date. The class shall be scheduled a minimum of 2 weeks in advance of the week it is to be held. Submit a course syllabus.

### **3.05 Adjusting / Cleaning / Protection**

A. Refer to Section 17110.

**\*\*END OF SECTION\*\***

# SECTION 17110 INSTRUMENTATION AND CONTROL SYSTEMS

## PART 1 - GENERAL

### 1.01 Summary

- A. Scope: This section provides specifications for all instrumentation and control system equipment, panels, and necessary appurtenances for an integrated control system. These Specifications and Drawings include descriptions of functional operation and performance, as well as standards, but does not necessarily enumerate detailed specifications for all components and devices which are necessary. However, all components and devices shall be furnished and installed as required to provide complete and operable systems capable of providing the functions and meeting the performance set forth hereinafter.
- B. The work of this section shall be performed by a qualified System Integrator. The contractor shall retain the services of a System Integrator to provide complete, assembled, installed, setup and testing of all instrumentation and control system components. The System Integrator shall provide for the PLC System, Control Panels, Motor Control Centers, VFD, and field instrumentation. , Industrial Computer (PC Work Station) shall be provided by others.
- C. See Specification Section 17201 for the PLC system and Control Panel Specifications.

### 1.02 References

- A. General: The work shall comply with the most recent Codes and Standards as published at the date of the Contract and as listed in the Specifications.

<u>Reference</u>	<u>Title</u>
NFPA 70	National Electrical Code – Latest Edition
NFPA 101	Life Safety Code - Latest Edition
UBC	Uniform Building Code - Latest Edition
ANSI	American National Standard Institute
ASTM	American Society for Testing and Materials
ASME	American Society of Mechanical Engineers
IEEE	Institute of Electrical and Electronic Engineers
ISA	International Society of Automation
JIC	Joint Industrial Council
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
SAMA	Scientific Apparatus Makers Association
UL	Underwriters' Laboratories, Inc
EIA	Electronic Industries Association
	Local Mechanical and Electrical Codes
	Any additional codes effective at the job site

### **1.03 Submittals**

- A. Submittals for all ICS equipment shall be prepared and submitted in accordance with Section 01300 and as described in Section 17010.
- B. Operation and Maintenance Manuals
  - 1. General: The CONTRACTOR shall provide Operation and Maintenance (O&M) manuals in accordance with Section 01300 and as described in Section 17010.

### **1.04 Quality Assurance**

- A. Performance and Design Requirements: For the purpose of standardization, all components shall be manufactured or furnished by one manufacturer, except as noted or approved.
- B. Equipment Surge Protection:
  - 1. All electronic equipment shall successfully withstand surges in AC power circuits as specified in IEEE C62.41. Successfully withstanding transients requires that none of the following conditions occur as a result of the transient:
    - a. Erroneous output
    - b. Component failure
    - c. Calibration change exceeding normal tolerances

### **1.05 Delivery, Storage, and Handling**

- A. Refer to Section 17010, General Conditions, Instrumentation

### **1.06 Project / Site Conditions**

- A. The Instrumentation and Control System (ICS) shall be installed in a Water Facility which will be subjected to environmental conditions where temperatures may vary from 20 to 115 degrees F; relative humidity may vary from 10 to 100 percent; and trace quantities of moisture and dust may be present.

### **1.07 Warranty**

- A. Refer to Section 17506, Extended Warranty and Maintenance

### **1.08 Maintenance**

- A. Refer to Section 17506, Extended Warranty and Maintenance

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers**

- A. These specifications describe equipment of a specific manufacturer and are not designed to limit competition. Unless noted as a "sole source," "no or equal," or "No substitutions allowed"; the naming of the manufacturer on which the specifications and plans are based is not an endorsement of that manufacture, but is instead intended to describe a level of quality and demonstrate the functionality of the system.
- B. The ICS components specified in these Specifications and shown on the Drawings are based upon the use of equipment, devices and panels manufactured by the companies specified in the following Sections of these Specifications.

- C. The use of substitute or “or ENGINEER approved equal” equipment will be considered. Such equipment will be acceptable only on the basis that any revisions in the engineering, design and/or construction of the structure, piping, appurtenant equipment, electrical work, etc., required to accommodate such a substitution, shall be made at no additional cost to the Owner

## **2.02 Equipment and Materials**

- A. All furnished instruments and control system components shall be as specified in these Specifications. Equals or exceptions shall be approved by ENGINEER prior to procurement.
- B. All products shall be new and approved for the specific applications shown on Contract Drawings or specified in these Specifications.
- C. Same products shall be of a single manufacturer.
- D. Products furnished for modification of existing control panels, except for the PLCs, shall be compatible with the existing products and from the same manufacturer, unless the existing products are no longer available
- E. Products installed in classified areas shall be approved for that classification and meet all the pertinent Standards and Code requirements.
- F. Level Switch – Probe Type
  - 1. Electrodes: 316 Stainless Steel
  - 2. Shield Material: PVC
  - 3. Cord type and material shall be NSF rated.
  - 4. Cord length shall be 40 feet.
  - 5. Install level switches per Contract Drawing details.
  - 6. Provide electrode fittings, reference probes, and level control relays as required
  - 7. The level switch shall be Gems Warrick Series 3Y, or equal.
- G. Electromagnetic Flow Measuring Systems:
  - 1. Instrument
    - a. Magnetic flow meter system shall be of the microprocessor-based, high impedance electromagnetic induction type and produce a DC pulsed signal directly proportional to and linear with the liquid flow rate. Complete zero stability shall be an inherent characteristic of the flow meter system. The magnetic flow meter system shall include a metering tube, signal cable (length to be determined by the Contractor), and signal converter/transmitter. The metering tube shall be constructed of 316 stainless steel with flanged connections, have at least two diametrically opposed self-cleaning electrodes compatible with the process fluid, a nonconductive liner material rated for raw sewage service. For the intended service as described in this document, a meter housing rated for IP68/NEMA 6X continuous submergence conditions and an exterior coating consisting of a corrosion resistant finish. Output signal from the metering tube shall be fed through a continuous forty-foot signal cable pre connected by the manufacturer to the metering tube and factory prepared ends that are prepared and ready to be terminated at the remote signal converter. 316 stainless steel grounding rings shall be provided. The flow meter shall have an operable measurement range of 1000:1, and shall have bi-directional measurement capability with forward, reverse and net totalization.
    - b. The signal converter/transmitter shall use a DC pulsed technique to drive bi-polar flux-producing coils and convert the DC pulse signal from the tube to a 4-20mA signal. The signal converter/transmitter shall be microprocessor based, and have a LCD back-lit

display with forward/reverse/net flow register, flow rate indication register, and alarm monitoring icon housed in an IP65/NEMA 4X enclosure. The transmitter shall provide empty pipe detection, have an integral self-test feature to verify proper operation of the electronics, provide high and low alarms, and an automatic zero adjustment.

- c. The magnetic flow metering system shall be hydraulically calibrated by direct volumetric and weight standards at a facility which is traceable to National Institute of Standards Technology or NAMAS. A real-time computer generated Calibration Test Report shall be provided containing the actual flow as measured by the standard, the flow as indicated by the magnetic flow meter system, and the percent of difference. The calibration facility shall be certified to 0.2% accuracy.
- d. The magnetic flow metering system shall conform to the following technical specifications:
  - 1) Flow Tube: IP68/NEMA 6X Designed for continuous submergence
  - 2) Transmitter: IP65/NEMA 4X Remote signal converter
  - 3) Accuracy: 0.20% of reading or +/- 0.003 ft/sec up to a maximum velocity of 49ft/sec
  - 4) Repeatability: 0.05% or +/- 0.008ft/sec.
  - 5) Rangeability: 1000:1
  - 6) Temperature: Up to 80°C.
  - 7) Power: 24VDC. Power consumption <20VA with transmitter
  - 8) Output: 4 to 20mA into 800ohms. Isolated and fully programmable
  - 9) Two pulse/frequency outputs

## 2. Flow Metering Tube

- a. The magnetic flow elements shall operate by means of pulsed DC electromagnetic, volumetric flow rate measurement. The flow meter shall be insensitive to changes in the viscosity and density of the fluid that is being measured. The flow meter shall be inherently designed for continuous zero stability. The output signal shall be highly accurate and directly proportional to the fluid flow rate. The flow meter shall be designed and manufactured to international quality procedures (ISO 9001).
- b. The flow meter tube shall be constructed of type 316 stainless steel. The magnetic field generating coils shall be located within the metering tube. The coils shall be potted with an epoxy-base compound. An insulating interior liner of elastomer shall be inserted and turned out against the flange faces. The metering tube shall be capable of withstanding a test pressure of at least 75 PSI. The flow meter shall have 150 pound ANSI or AWWA Class D flanges and built in grounding electrodes. The flow meter shall be rated for continuous submergence to a depth of 30 feet in accordance with the requirements of IP68. The metering tube shall have an internal neoprene liner that is certified for use with raw sewage. The flow meter electrodes shall be of the protruding self-cleaning design made of type 316 stainless steel. Removable electrodes or ultrasonic cleaners are not acceptable. The input impedance of the electrodes shall be greater than ten million (10,000,000) mega ohms to achieve a meter accuracy that is completely unaffected by coatings. The laying length shall be the current standard for magnetic flow meters (60"). 316 stainless steel grounding rings shall be included with the flow metering system. The grounding rings shall insert between both flanges and shall not interfere with the internal flow profile. All gaskets for proper metering tube installation shall be included. The gaskets shall be made of a material suitable for raw sewage service and shall not be affected by any petroleum products or byproducts.

- c. The flow meter shall be hydraulically calibrated in a laboratory that is internationally accredited by an agency such as NIST or NAMAS. The method of the initial calibration shall utilize volume and weight testing. All components of the device being provided as a result of these specifications shall be tested as a complete system. The results of this testing shall be certified by the agency and documentation of the test shall be provided with the equipment.
  - d. The flow meter accuracy shall be guaranteed with no more than five straight unobstructed pipe diameters upstream and three pipe diameter downstream of the flow meter. The accuracy of the flow meter as a system shall be three tenths (0.3) percent of the flow rate regardless of flow direction. The repeatability of the flow meter shall be a minimum of five one-hundredths (0.05) percent of the flow rate.
3. Flow Transmitter
- a. The signal converter for the flow meter shall be housed in an IP65/NEMA 4X enclosure. This enclosure shall be suitable for pipe stand or wall mounting.
  - b. The signal converter shall be provided with a universal switching power supply. The range of this power supply shall be 24VDC. This power supply shall provide the necessary output to the signal converter and the flow meter's magnetic coils. The power supply shall have an inherent system to protect the electronics from lightning and/or power surges.
  - c. The signal converter electronics shall be microprocessor based. The converter shall provide an output of 4 to 20 milliamps at impedances of zero to 800 ohms. This output signal shall be directly proportional to the rate of flow through the meter. The signal converter shall have a second output for remote totalization. This output shall be a pulsed open collector capable of 800 HZ, at less than 35 VDC and 250 milliamps. The pulse width shall be software adjustable to match the input requirements of the totalizer. The range of the pulse width shall be from thirty-two one-thousandths (0.032) to two thousand (2000) milliseconds with a weighing factor range from one one-thousandths (0.001) to one thousand (1000).
  - d. The input impedance shall be greater than 10,000,000 megohms. The input span shall be continuously adjustable by means of a keypad with a veloCounty range from five tenths (0.5) to thirty (30) feet per second. The system supplied shall not require circuit or component changes to achieve calibration changes. The signal converter shall be designed for use with the flow meter. The system shall not require recalibration when signal converters are changed.
  - e. The signal converter shall have a local display. This display shall be calibrated in engineering units and provide instantaneous flow rates and totals. This display shall be a liquid crystal backlit screen with easily readable representations of the configuration and flow rate. The display shall offer the flow rate in either a percentage or in direct engineering units. This option shall be selectable at the local display. The display shall also provide a real time total flow indication. All configuration information, system adjustment entries and error messages shall be represented in clear, easy to understand terms. The internal program shall detect and reject incorrect entry values. The rejection of these incorrect entries shall be displayed as error messages on the screen. Failure of the signal converter shall be displayed as an error message. A failure of the converter shall trigger a contact that provides an output for a remote failure alarm. The display shall not require a book, manual or other documentation to translate diagnostic coded error messages.
  - f. The signal converter shall have integral zero return capability. This function shall be fixed at four milliamps. The zero return function shall be activated by an external contact being closed.

- g. The range setting of the signal converter shall be adjustable through its entire range from zero to one hundred (100) percent of the flow meter's capacity. This range and other adjustable settings shall be represented on the local display screen.
  - h. The signal converter software shall include an integral self-diagnostic program. This program shall continuously monitor operational modes and alarms, as well as, electrode reference voltage for indications of flow meter coil failures. Failure of the flow meter as detected by this software shall trigger the zero return function and the remote alarm contact. The software shall also include an algorithm for the reduction of noise that is generated by any other process equipment.
  - i. The signal converter shall have an operating temperature range from 30 to 150 degrees Fahrenheit. A one degree Fahrenheit change in the ambient temperature shall result in a change in the output reading of the flow meter that is less than one one-hundredths (0.01) percent of the flow reading. A 10% change in the supply voltage shall result in less than a two tenths (0.2) percent change in the output reading of the flow meter.
4. The flow meter system, including the flow elements and remote signal converter (transmitter) shall be manufactured by ABB Ltd., Endress+Hauser Electromagnetic Flowmeter with 316 stainless steel Grounding Rings.

#### H. Flow Switch – Paddle Type

- 1. Paddle switches shall be activated by paddles in a pipe flow stream.
- 2. Wetted materials shall be 316 stainless steel
- 3. Minimum pressure rating shall be 300 psi
- 4. Switches shall be SPDT rated 125 VA at 120/240 VAC, 60 Hz
- 5. Actuation points for flow and no flow shall be adjustable.
- 6. Flow switches shall be suitable for use in pipe sizes from 1 inch to 60 inches and shall have a 1-inch MNPT process connection.
  - a. Flow Switches shall be ITT McDonnell & Miller Series FS7 Series, Georg Fischer Signet, or approved equal.

#### I. Pressure Switch

- 1. Pressure and differential pressure switches shall have an adjustable (10` percent) differential (deadband) to eliminate instability due to pressure cycling. Pressure tap connections shall be 1/2-inch NPT and conduit connection shall be 3/4-inch NPT or larger.
- 2. Materials:
  - a. Bourdon tube: 316 stainless steel.
  - b. Diaphragm seal housing: 316 stainless steel.
  - c. Pulsation dampeners: 316 stainless steel.
  - d. Switch isolating ball valves: 316 stainless steel.
- 3. Accessories:
  - a. Provide ball valve to isolate pressure switch from source.
  - b. Provide pulsation dampeners on all pressure switch applications which involve positive displacement equipment including positive displacement plunger pump systems, positive displacement lube pump systems, diaphragm pump systems and positive displacement blower or compressor systems.
  - c. Provide protector to separate process fluid from the pressure element,

- d. System fill applications – diaphragm seal and sealed sleeve.
4. System fill material: Utilize halocarbon fill for process applications involving strong oxidizing agents. Agents include but are not limited to: Chlorine (CL<sub>2</sub>), Potassium Permanganate (KMNO<sub>4</sub>), Ferric Acid (FeCl), Sodium Hydroxide (NaOH), Sodium Hypochlorite (NaOCl), and Aluminum Sulfate, (A<sub>12</sub>(SO<sub>4</sub>)<sub>14</sub> H<sub>2</sub>O). Utilize manufacturer's standard fill for other applications. Ensure fill is suitable for application temperatures.
  5. On applications where a pressure switch and a pressure gauge are used at the same location, it is permissible to utilize one pulsation dampener and diaphragm seal to isolate both elements from the process fluid.
  6. Design and fabrication:
    - a. Pressure Switches shall be hermetically sealed non-mercury contact switches.
    - b. Two (2) SPDT contacts rated 1 amp inductive at 125 VDC and 5 amp inductive at 120 VAC. Set points between 30 and 70 percent of switch rated working range Operating pressure not to exceed 75 percent of switch rated working range.
    - c. Accuracy: Better than 1 percent of full scale.
    - d. The pressure switches shall have a watertight enclosure.
    - e. Pressure switches shall be United Electric Controls with appropriate diaphragm seals, Mercoïd, Ashcroft or approved equal.
  - J. Pressure Transmitter:
    1. The Pressure transmitter shall be an overload-resistant and function-monitored pressure transmitter with ceramic sensor.
    2. The transmitter shall be a 2-wire, high-performance capacitive pressure transmitter with digital communications capabilities including HART, Profibus PA or FF as required by the plans.
    3. Measure capacitance changes in the sensor as pressure varies and produces a linear 4-20mA DC output proportional to the pressure. The unit shall have self-diagnostic capability and a non-volatile memory; Histo-ROM memory module for monitoring of events, configuration changes and periodic recording of temperature/pressure values.
    4. Display shall be an integrally mounted 4-line LCD scaled with engineering units.
    5. Transmitter shall have a static pressure limit at least 1.5 times the nominal pressure range. Unit shall be 24VDC loop-powered with self-diagnostic capability and a non-volatile memory.
    6. Sensor shall be a high purity aluminum oxide ceramic element with no oil fill and an elastomer seal.
    7. The unit shall be rated for a maximum process temperature range of minus 40°F to 266°F [process connection dependent] in an ambient environment of minus 40 degrees F to 185 degrees F.
    8. Reference accuracy capability shall be up to +/- .075% of URV including hysteresis and non-reproducibility in accordance with IEC 60770. Total performance accuracy including hysteresis and non-reproducibility in addition to thermal change of the zero point shall be up to +/- .5% URL.
    9. The transmitter shall be programmable via the integral LCD display, personal computer or hand held device.
    10. Unit shall have ATEX, FM, CSA or IEC Ex approvals as required.
    11. The pressure transmitter shall be a Rosemount 2088, Endress+Hauser- Cerabar S PMC51/PMC71, or an approved equal.

- The two pressure transmitters shall be housed together in a single instrumentation enclosure. The instrumentation enclosure shall be an O-Brien Trakmount A1T Enclosure. No substitutes allowed.

## **2.03 Components and Accessories**

### **A. Pilot Devices:**

- Indicating lights, pushbuttons, and selector switches shall be miniature oil-tight units. Time clocks in control circuits shall be NEMA IC1, B150, rated 5 amperes inductive at 120 volts AC. Contact blocks for signal circuits shall be rated at 0.06 amperes at 30 volts AC or DC and shall be hermetically sealed reed switches. Pilot lights for 120 volt AC circuits shall be full voltage LED type. Pilot lights of 24 volt circuits shall be rated 28 volts. Individual pilot light assemblies shall be "push-to-test" type.

### **B. Relays:**

- All relays used for instrumentation work shall be plug-in types utilizing EIA standard tube socket configuration plugs. Sockets shall be heavy-duty, surface mounted, industrial type with barrier protected screw type terminals and shall be a one-piece melamine plastic molding. Sockets shall be rated not less than 5 amperes at 125 RMS working volts.
- As a minimum, relays for general purpose use shall have double-pole, double-throw (DPDT) contacts. They shall bear ratings of 10 amperes at 120 volts AC and 28 volts DC. Relay frames shall be constructed of laminated phenolic and shall be provided with a clear polycarbonate dust cover. Relays for switching high level signal circuits (4 to 20 mA) shall be similar to the above; except the contacts shall be rated 3 amperes and the relays shall be hermetically sealed.
- Relays for switching power or control loads with in-rush currents in excess of 5 amperes shall be similar to the above except the contacts shall be single-pole, single-throw (SPST), double-break, rated 20 amperes at 120 volts AC and 28 volts DC, and 1 horsepower at 120 volts AC.
- Relays shall be IDEC, or an approved equivalent.

### **C. Current Alarm Trip (Switches):**

- Current alarm trips shall be single- or multi-channel type as required. Units shall accept voltage or current input signals. Dead band shall be factory set at 1 percent of full span for single trips. Alarm trips shall be equipped with 10 AMP DPST contacts.
- Alarm trips shall include setpoint dials calibrated 0-100 percent for each trip point. Single alarm trips shall include a dead band adjustment dial calibrated 0-100 percent.
- Alarm trips shall be AGM Electronics Model TA-4030, Moore Industries Model DCA, or equal.

### **D. I/I Converters:**

- Current to Current (I/I) converters shall accept one 4-20 mA signal and convert to two (2) 4-20 mA DC signals with an uncertainty not exceeding 0.25 percent of full scale. Each output signal shall be independent of each other, and isolated from input signal. The units shall be AGM Series 4000 or equal.

### **E. DC Power Supplies:**

- Twenty-four volt units shall be used to supply instrument controls and loops as required in the plans and detailed specification schedules. Power output shall be free of noise, have negligible ripple, and remain stable under varying system load conditions.

### **F. TERMINAL BLOCKS AND WIRING**

1. Terminal blocks shall be screw terminal type with box-clamp type pressure plates. Terminal blocks shall be rated minimum 300 volts. Each terminal block shall be identified by a distinct number (TB-1, TB-2, etc.) designated by the panel manufacturer. All terminal points shall be assigned a distinct number. All terminal points for "Common" bus shall be designated by "COM." Terminal points dedicated for 120 VAC buses shall be identified by L-1, L-2, etc. Terminal points for the ground wires shall be labeled "GND."
2. All interconnecting wiring between panels or between panels and field devices shall be connected to terminal blocks. All panel internal wiring shall be installed in plastic raceways (Panduit). Unless otherwise shown on the Drawings, all 120 VAC wiring shall be No. 14 AWG. All wiring for analog signals shall be No. 16 AWG. All wiring for 24 VDC discrete signals shall be No. 16 AWG. All wire shall be standard copper. Conductors shall be individually identified using colored thermoplastic insulation or distinct labels.
3. Conductor Identifications: Identify each conductor by a consecutive unique number, letter, or number-letter combination. Each conductor shall have the same identification at all terminals and tie points. Conductors connected to the same terminal or tie point shall have the same identification. Conductor identification shall be as shown below with modifications necessary to provide a unique conductor number for each interconnecting conductor:
  - a. OPNLTB #T #/DPNLTB #T #/C #, where
    - 1) OPNL is Origination Control Panel, TB # is Terminal Block Number, T # is Terminal Number, DPNL is destination Control Panel, and C # is the three digit conductor sequential number. The following example is shown as the guidance for clarification:
      - a) BBCPTB01T12/ASCPTB01T12/100, where
        - (i) BBCP is Blower Building Control Panel, TB01 is Terminal Block 01, T12 is Terminal Point 12, ASCP is Activated Sludge Control Panel, and 100 is the conductor unique number.
        - (ii) Use filed device Tag Numbers for connections between two filed devices and between a field device and a panel.
4. All relay contacts which will be connected to external panels or devices shall be wired to terminal blocks,

#### G. Accessories

1. Provide instruments with manufacturer's identification nameplate showing:
  - a. Manufacturer's model number
  - b. Manufacturer's serial number
  - c. Range (English units)
  - d. Power supply requirement

#### H. Nameplates

1. Machine engraved laminated phenolic nameplates shall be provided for all panel mounted equipment. Nameplate engraving shall be as shown on the Drawings. The nameplates shall also include the instrument tag number in small size lettering on the last line of the nameplates. Nameplates shall be attached to the panel with a minimum of two self-tapping stainless steel sheet metal screws. Adhesive attachment is not acceptable. The OWNER reserves the right to review and change nameplates wording at no additional cost prior to the engraving. Machine embossed adhesive labels shall identify the tag number of instruments inside panels. All nameplates shall be included in CONTRACTOR's submittal for review and approval

I. Door Intrusion Switches

1. Door intrusion switches shall be Sentrol Model 2507A or approved equal.

J. Vibration Transmitter

1. Device Type: Sensor / Transmitter
2. Linear VeloCounty: 0.0 to 2.0 in/sec
3. Frequency Range: 180 to 60,000cpm
4. Broadband Resolution: 0.01 in/sec pk
5. Operating Temperature: -40 to 85 degree C
6. Output: 4-20mA
7. Sensor element: Ceramic
8. Mounting: Threaded type
9. Housing Material : Stainless Steel
10. Axis: Three axes
11. Vibration Transmitter shall be IMI Sensors model M640B02 or equal.

**PART 3 - EXECUTION**

**3.01 Installation**

- A. Field instruments shall be mounted on 2-inch pipe stands unless shown adjacent to a well or otherwise noted. Instruments attached directly to concrete shall be spaced minimum two inches from the mounting surface by use of phenolic spacers or framing channel. Expansion shields or cast-in-place inserts shall be used for securing equipment or supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform. All instruments shall be installed so that taps, parts, and the like, are available for in-place calibration and test without removal.
- B. Pressure Transmitters – Dual Pressure Transmitters shall be mounted in a stainless steel instrumentation enclosure.

**3.02 Field Quality Control**

- A. The instruments shall be field calibrated and tested. Field testing shall be provided for verification of contract requirements and pertinent manufacturer published performance specifications for performance parameters essential to the proper operation of the system. As required by the OWNER, any instrument of suspicious operation shall be recalibrated and retested until proved satisfactory to the OWNER at no addition cost.
- B. Elements such as controllers, electronic function modules, and the like, shall be tested and exercised to demonstrate correct operation, first individually and then collectively as part of a functional network system.

**\*\*END OF SECTION\*\***

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# SECTION 17201 CONTROL PANELS

## PART 1 - GENERAL

### 1.01 Summary

A. Scope: This section provides specifications for all control panels provided under this project as shown on the Contract Drawings.

### 1.02 References

A. The work shall comply with the most recent Codes and Standards as published at the date of the Contract and as listed in the Specifications.

<u>Reference</u>	<u>Title</u>
ASTM A269	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
JIC EMP-1	Mass Production Equipment
NEMA	National Electrical Manufacturers Association
ICS 4	Terminal Blocks for Industrial Use
ICS 6	Enclosures for Industrial Controls and Systems
NEMA 250	Enclosures for Electrical Equipment (1000 V Maximum)
NFPA	National Fire Protection Association
NFPA 70	National Electric Code

### 1.03 Submittals

A. Shop Drawings

1. Submit shop drawings in accordance with Special Provisions and Section 17010
2. Scaled panel elevation, sub-panel layout, instrument panel layout and nameplate layout drawings.
3. Panel and sub-panel materials of construction
4. Panel access openings
5. Conduit and wiring access locations
6. Internal wiring and terminal block drawings
7. Scaled layouts of any graphic panels
8. When panel color is selected, submit evidence of written statement advising electrical equipment manufacturers, subcontractors and other panel sources for the Project of the selected color/manufacturer and color number
9. Submit proposed modifications of existing panels with detailed, dimensioned drawings

B. Submit a complete list of equipment, materials, and any details required to demonstrate that each control panel will function properly as a unit. The submittal shall include:

1. Detailed descriptions of equipment including weights, dimensions, installation requirements, and heat dissipations
  2. Internal panel layouts indicating spacing and dimensions
  3. Panel front and side layouts
  4. Catalog cuts of all devices used
  5. Control schematics, ladder diagrams, and interconnection drawings
  6. Nameplates, designations, sizes, mounting methods, and locations
  7. SCADA, PLC and OIT programming by Others.
- C. Samples: Provide color selection of a minimum of 10 colors for panel finish paint selection.
- D. Operation and Maintenance Manuals: Submit operation and maintenance manuals per Special Provisions and Section 16010.

#### **1.04 Quality Assurance**

##### **A. Miscellaneous**

1. Prior to placement of conduit feeds, assure approved control panel layouts available.
2. Assure completely matching color tones for any individual color specified.
3. Provide panel with the required NEMA rating per NEMA Publication No. 250 to meet classifications shown on drawings or specifications.
4. Provide panels with openings and clearances to accommodate existing conduits and conductors.

##### **B. Manufacturer Services**

1. Provide equipment manufacturer's services at the job site for the minimum man-days listed below, travel time shall be excluded:
  - a. Ten (10) man-days to check the installation, calibrate the equipment, supervise start-up, and supervise testing of the system
  - b. Five (5) man-days to instruct the Owner's personnel in the operation and maintenance of the control panel

#### **1.05 Delivery, Storage, and Handling**

- A. Refer to Section 17010, 1.06 for requirements.

#### **1.06 Project / Site Conditions**

- A. The Instrumentation and Control System (ICS) shall be installed in a Wastewater Treatment Plant which will be subjected to environmental conditions where temperatures may vary from 20 to 115 degrees F; relative humidity may vary from 10 to 100 percent; and trace quantities of moisture and dust may be present.

#### **1.07 Sequencing and Scheduling**

- A. Sequencing and scheduling plan shall be provided that minimizes pump station downtime. Note that the pump station must remain operational during all phases of construction. For additional requirements refer to Special Provisions.

## **1.08 Warranty**

A. Refer to Section 17506 for requirements.

## **1.09 Maintenance**

A. Spare Parts shall be provided within a single separate plastic, metal or wooden container (cardboard type boxes are not acceptable) with a listing of each component including manufacturer name, and model number:

1. Provide minimum six (6) sets of spare fuses and lights for each fuse or light type
2. Provide minimum two (2) sets of control switches, relays and pushbuttons for each of these control devices
3. Provide one (1) PLC Power Supply.
4. Provide one (1) spare discrete PLC output module of each type in use within the Control Panel.
5. Provide one (1) spare analog PLC input module of each type in use within the Control Panels.
6. Provide one (1) spare analog PLC output module of each type in use within the Control Panel.
7. Provide one (1) spare PLC processor module of each type in use within the Control Panel.

## **PART 2 - PRODUCTS**

### **2.01 Manufacturers:**

A. When Control Panel is indoors and free-standing, Control Panel Enclosure shall be Hoffman Bulletin A30 or approved equal

1. Free-Standing
2. Single Access
3. NEMA Type 12.
4. Minimum Dimensions: 90" H x 36" W x 24" D.

B. When Control Panel is outdoors and free-standing, Control Panel Enclosure shall be Hoffman Bulletin A30S4 or approved equal

1. Free-Standing
2. Single Access
3. NEMA Type 12.
4. Minimum Dimensions: 90" H x 36" W x 24" D

C. When Control Panel is part of a motor control center, the control panel shall be the same manufacturer as the Motor Control Center.

1. Minimum Width shall be 24" unless otherwise noted on the contract drawings.

### **2.02 Equipment and Materials**

A. Control Panels:

1. Materials:
  - a. Front Panel, Sub-panel or Front Door: Steel.

- b. Frame and Bottom Angles: Steel.
  - c. Top, Sides, Back, Sides, and Back Door: Steel.
  - d. Hinges: Stainless steel.
  - e. Nameplates: Phenolic.
  - f. Filler Panels: Steel
2. The Control Panels shall be of same construction and configuration as shown on the Drawings and specified in these Specifications. All indicator lights, switches, recorders and digital displays shall be mounted on the doors.
  3. The back-panel and side-panels shall be used to install instrument modules, signal conditioners, relays, power supplies and other associated components within the Control Panel.
  4. The Control Panels shall be fully gasketed and NEMA rated for the specific Plant areas. The panels shall be completely factory assembled, wired and tested. All field wiring shall be terminated in terminal blocks. All components shall be mounted so as to facilitate easy removal for service.
  5. The panels shall be provided with adequate forced ventilation to ensure that the temperature rise within the panel section does not exceed design temperatures for the components within the panel section. The panels shall also be provided with heaters, to prevent condensation and sunshields to dissipate heat, as required.

B. Programmable Logic Controllers:

1. Design Description:

- a. Programmable Automation Controller shall be Allen-Bradley by Rockwell Automation, no equal.
- b. The Programmable Automation Controller shall be designed to provide the basic requirements of the application with the capability of expansion to address particular needs. The expansion shall exist as additional I/O expansion modules or as remote I/O connected through one of the networks available.
- c. Modules are defined herein as devices that can be removed individually from its position for replacement and are keyed to allow installation in only one direction. The design must prohibit upside down insertion of the modules as well as safeguard against the insertion of a module into the wrong position via an electronic method for identifying a module. Electronic keying performs an electronic check to insure that the physical module is consistent with what was configured.
- d. The Programmable Automation Controller shall have downward compatibility whereby all new module designs can be interchanged with all similar modules in an effort to reduce obsolescence.
- e. The Programmable Automation Controller shall have the ability to be updated electronically to interface with new modules.
- f. All hardware of the Programmable Automation Controller 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 +185 degrees F per IEC 60068-2-1 (Test Ad, Operating Cold), IEC 60068-2-2 (Test Bd, Operating Dry Heat) and IEC 60068-2-14 (Test Nb, Operating Thermal Shock).

- g. The Programmable Automation Controller hardware shall function continuously in the relative humidity range of 5% to 95% with no condensation per IEC 60068-2-30 (Test Db, Unpackaged Damp Heat).
- h. The Programmable Automation Controller system shall be described and tested to operate in a high electrical noise environment.
- i. The Programmable Automation Controller shall have the following capabilities as shown in the table below:

Capability	1769-L36ERM
User Memory	3.0 Mb
Max Number of 1769 I/O Modules	30
Ethernet IO IP nodes	48

- j. The Programmable Automation Controller shall support Produced/Consumed Connections which allows seamless exchanging of data between multiple Logix based Controllers.
- k. The Programmable Automation Controller shall use multiple independent, asynchronous scans. These concurrent scans shall be designated for processing of input and output information, program logic, and background processing of other controller functions. Input and output devices located in the same backplane (local I/O) as the CPU will be produced at the rate of the configured RPI (Requested Packet Interval).
- l. The Programmable Automation Controller shall have the ability to support multiple data communications links by using Ethernet/IP, DeviceNet, and other 3rd party networks.
- m. The Programmable Automation Controller shall have one dedicated Universal Serial Bus Type B port (USB 2.0) communicating at 12mb/sec The USB port shall be used as programming port. The USB port must be usable for programming and data monitoring purposes.

2. Controller Hardware:

- a. The CPU shall be a self-contained unit, and will provide control program execution and support remote or local programming. This device will also supply I/O scanning and inter-controller and peripheral communication functions.
- b. The operating system firmware shall be contained in non-volatile memory. An option shall be possible to store both the user program and system firmware in a removable non-volatile memory for backup/restore purposes.
- c. The operating system firmware can be updated via a separate software update tool to allow for easy field updates. The controllers shall allow the operating system to be updated using a suitably configured removable non-volatile memory card.
- d. The controller shall contain a minimum of 3 Mbyte of user memory as follows:  
1769-L36ERM Controller, CompactLogix 5370
- e. The CPU within the system shall perform internal diagnostic checking and give visual indication to the user by illuminating indicators on the controller's faceplate.

LED Function	Label	Color
Module Status	OK	Green/Red

Force State	FORCE	Yellow
Controller Mode	RUN	Green
SD Activity	SD	Green/Red
I/O State Status	I/O	Green/Red
Network Status	NS	Green/Red
Ethernet port 1 Link status	Link 1	Green
Ethernet port 2 Link status	Link 2	Green

- f. The CPU shall include a method of storing energy to provide power backup for user programs and data when the main power supply is not available.
  - g. The front panel of the Controller shall include a mounted mode switch. The mode switch shall select the following Controller modes:
    - 1) RUN – No control logic edits possible, program always executing
    - 2) PROGRAM – Programming allowed, program execution disabled
    - 3) REMOTE – Programming terminal can make edits and change processor mode, including test mode, whereby the logic executes and inputs are monitored, but edits are not permanently active unless assembled.
  - h. The front panel of the Controller shall include a USB port, to support upload and download, online edits, firmware upgrades, and bridging to other modules in the same chassis.
  - i. The front panel of the Controller shall include an integrated latching mechanism for the purpose of securing the removable Secure Digital card.
  - j. The Programmable Automation Controller shall operate with or without removable media installed.
  - k. All system modules, local and remote chassis shall be designed to provide for free airflow convection cooling. No internal fans or other means of cooling, except heat sinks, shall be required.
  - l. The controller shall include an integrated Real Time Clock (RTU). This clock value should be in a form of a predefined tag and should be accessible via logic or remotely.
3. Power Supplies:
- a. The Programmable Automation Controller shall operate 18-32 VDC (24VDC nominal).
  - b. A single main power supply shall have the capability of supplying power to the CPU and local input/output modules. Other power supplies shall provide power to remotely located racks.
  - c. The power supply shall automatically shut down the Programmable Automation Controller system whenever its output power is detected as exceeding 125% of its rated power.
  - d. The power supply shall provide surge protection, isolation, and outage carry-over of up to 6 cycles of the AC line (120-240VAC, 50/60Hz) or 40ms @ 24VDC.
  - e. Design features of the Programmable Automation Controller power supply shall include a diagnostic indicator mounted in a position to be easily viewed by the user. This indicator shall provide the operator with the status of the DC power applied to the backplane.
  - f. At the time of power-up, the power supply shall inhibit operation of the Controller and I/O modules until the DC voltages of the backplane are within specifications.
  - g. In addition to the electronic protection described above the power supply shall offer a failsafe fuse that is accessible by the user.

#### 4. Program Creation and Storage:

- a. Memory capacity shall be selectable to allow for the most economical match to the intended application. It shall be possible to upgrade to a controller with a larger memory size simply by saving the program, upgrading the controller and downloading the program to the new system without having to make any program changes.
- b. The energy storage module shall provide enough power for the controller to write all program and variable data to internal non-volatile memory during a loss of power. A faulty energy storage module shall generate a minor fault and will be detectable in ladder logic.
- c. The controller shall provide the capability to use commercially available, removable nonvolatile Secure Digital memory cards. Secure Digital cards shall be available from the supplier as an industrial rated device suitable for use in the same environment as the controller.
- d. The controller will have the ability to store the user program, controller firmware and firmware for all other modules residing in the same chassis to the removable Secure Digital memory card. Additionally when memory is restored a user selectable option to be restored in Run mode or Program mode shall be provided.
- e. The removable Secure Digital memory card shall support a Windows file system allowing multiple files to be stored on the card. The user can manually trigger the controller to save or load from the card and also configure the controller to load from the card on power up.
- f. The operator should be able to backup volatile memory, including data and program logic onto a personal computer storage device.
- g. All user memory in the controller not used for program storage shall be allocable from main memory for the purpose of data storage. The Programmable Automation Controller system shall be capable of storing 4 data types:
  - 1) Predefined
  - 2) User-defined
  - 3) Module-defined
  - 4) Add-on defined
    - a) Predefined: Include the following data types:
    - b) User-defined: User defined data is related to structures. Each structure shall contain one or more data definitions, referred to as members. User defined tags shall contain up to 500 members.
    - c) Module-defined: Object includes a structure for each I/O module and system or module specific information (hidden from user).
    - d) Add-On defined: Add-on defined data type includes the Local and Parameter tags of the add-on instruction. It does not include the logic.
- h. All data shall have the option to be displayed in ASCII, Binary, Octal, Hexadecimal, or Decimal radices. Function-specific data types such as PID, Axis, Axis Group or Message shall have dedicated displays available annotating the meaning of specific control bits and words within them and allowing for selective control where appropriate.
- i. If instructions 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 enlarged program. All rung comments shall maintain their original links.

- j. 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.
  - k. The number of times a timer or counter can be programmed shall be limited only by the memory capacity to store these instructions.
  - l. Controller programs shall have immediate access to the sub elements of control structures by address and sub element mnemonic, such as timer accumulator value, timer done bit, or PID Process Variable value.
5. Security:
- a. The Programmable Automation Controller shall utilize digitally signed firmware to guard against malicious or fraudulent firmware downloads.
  - b. The Programmable Automation Controller shall be configurable to only accept firmware updates from authorized users.
  - c. The Programmable Automation Controller shall be configurable to allow modification only by authorized users.
  - d. The Programmable Automation Controller project files shall be configurable to allow modification only by authorized users.
  - e. It shall be possible to determine if the configuration of a Programmable Automation Controller has been modified.
  - f. It shall be possible to make this determination quickly – on the order of one second after the modification has been made.
  - g. It shall be possible to make this determination from another Programmable Automation Controller or from PC based software monitoring the Programmable Automation Controller.
  - h. It shall be possible to configure the Programmable Automation Controller as to what events constitute configuration changes. Examples include, but are not limited to:
    - 1) Online edits modified controller program
    - 2) Firmware update attempted
    - 3) Controller mode change
    - 4) Removable media inserted or removed
    - 5) Constant tag value changed
  - i. The Programmable Automation Controller shall keep a log of its most recent configuration changes. The Programmable Automation Controller shall expose the log for use by PC based software.
  - j. The Programmable Automation Controller shall allow individual tags, memory addresses, or variables to be configured by external applications according to each elements user defined access level.
    - 1) These individual tags, memory addresses, or variables shall be configurable to be read/write, read only, or none.
    - 2) The Programmable Automation Controller shall enforce these access levels at runtime.
  - k. The Programmable Automation Controller shall allow individual tags, memory addresses, or variables to be configured as constants to prevent controller logic from changing an elements value.

- l. Individual routines or custom instructions in the Programmable Automation Controller shall be configurable to prevent modification or viewing by unauthorized individuals.
  - m. Custom instructions can be digitally signed so that their contents can be easily audited for unexpected changes.
6. I/O Modules:
- a. All Input / Output (I/O) module housings and I/O modules shall be of rugged construction with modules installed in I/O chassis. Sufficient input and sufficient output modules shall be provided with the PLC to implement the specified control functions including a reserve capacity of 25 percent of the total provided.
  - b. All Discrete Input (DI) Modules, defined as contact closure inputs from devices external to the programmable logic controller module shall be shielded from short time constant noise. Individual inputs shall be optically isolated for low energy common mode transients to 1500 volts peak from user's wiring or other I/O Modules. The modules shall have LED lights to indicate a discrete input. Input modules shall be supplied with a maximum of 16 points per module, except where 32-point modules are required. Input voltage rating shall be provided as indicated on the Contract Drawings. Discrete input modules shall be Allen Bradley 1769-IQ16.
  - c. All Discrete Output (DO) Modules, defined as contact closure outputs for ON/OFF operation of devices external to the programmable logic controller module. Individual outputs shall be optically isolated for low energy common mode transients to 1500 volts peak from user's wiring or other I/O Modules. All output modules shall have LED lights to indicate output has been cycled ON by the controller. Discrete output modules shall be Allen Bradley 5069-OB16.
  - d. All Analog Input (AI) Modules, defined as analog inputs for 1 to 5 VDC or 4 to 20 mA signals, where an analog to digital conversion is performed and the digital result is entered into the processor. New inputs shall be provided for every scan. Analog inputs shall be supplied with a minimum resolution of 14 bits. Each Analog Input Module shall accept 16 isolated inputs. Each analog input shall be isolated from common. Analog input modules shall be Allen Bradley 1769-IF16C.
  - e. All Analog Output (AO) Modules, defined as analog output to output 4-20 mA signals, where a digital to analog conversion is performed and the analog result is produced on every scan. Analog output resolution shall be 12 bit minimum. Each Analog Output Module shall have 8 sink or source outputs. Each analog output shall be capable of driving into a 1500 ohm load. Analog Output modules shall be Allen Bradley Compact 5000
  - f. Isolated Contact Output Modules shall be provided as indicated on the Contract Drawings. Relay contacts shall be individually isolated per channel and shall be provided with a maximum of 8 points with each point having form C contacts. The Isolated Contact Output Modules shall be Allen Bradley 5069-OF8.
  - g. Output contact rating shall be 2 amps at 30 degrees C. Interposing relays shall be provided when controlled equipment current exceeds the contact output rating. Output module shall be supplied with a maximum of 16 points per module. Voltage shall be supplied as indicated on the Contract Drawings. Relay output module shall be Allen Bradley
  - h. Communications Modules shall be an Ethernet dual port 10-100M interface module (supports 128TCP/IP connections, up to 8 axis). The interface module shall support device level ring (DLR) and linear topologies. Ethernet Industrial Communication Modules shall be Allen Bradley.

- i. Analog current to current signal converter shall be an electrical isolation of current signals without auxiliary supply allowing the isolation between sensors, transmitter, actuators, and signal receivers. The current/current isolators shall be Allen Bradley compatible with 1769 modules.
  - j. Additional Power supply module shall be provided to support both 120VAC and 24VDC. Power supply module shall be compatible with 1769-L36ERM.
  - k. Provide field potential distributor modules 5069-FPD as required.
  - l. Expansion cable shall be 1769-CLL1 and compatible with 5069-L36ERM.
7. Manufacturer: The PLC system shall be Allen Bradley 1769-L36ERM Controller, CompactLogix 53. No Substitution is allowed.

## **2.03 Components and Accessories**

### **A. Control Devices (Other than Motor Control)**

1. Control Power Transformer: Provide 120-volt control circuit transformer if incoming power supply is not 120 volts. Provide copper wound, vacuum impregnated dry type control transformer with screw type terminals. Provide minimum 100 volt-ampere spare capacity that is in addition to the loads specified. Size transformers for a maximum voltage drop of 5% with 100% primary voltage during contactor inrush. Fuse one side to secondary winding and ground other side. Provide primary winding fuses on both lines. The control power transformers shall be 250 VA minimum.
2. Provide control relays, time delay relays, etc. as shown on Contract Drawings or as required for correct operation.
  - a. All relays used for instrumentation work shall be plug-in types utilizing EIA standard tube socket configuration plugs. Sockets shall be heavy-duty, surface mounted, industrial type with barrier protected screw type terminals and shall be a one-piece melamine plastic molding. Sockets shall be rated not less than 5 amperes at 125 RMS working volts.
  - b. As a minimum, relays for general purpose use shall have double-pole, double-throw (DPDT) contacts. They shall bear ratings of 10 amperes at 120 volts AC and 28 volts DC. Relay frames shall be constructed of laminated phenolic and shall be provided with a clear polycarbonate dust cover. Relays for switching high level signal circuits (4 to 20 mA) shall be similar to the above; except the contacts shall be rated 3 amperes and the relays shall be hermetically sealed.
  - c. Relays for switching power or control loads with in-rush currents in excess of 5 amperes shall be similar to the above except the contacts shall be single-pole, single-throw (SPST), double-break, rated 20 amperes at 120 volts AC and 28 volts DC, and 1 horsepower at 120 volts AC.
  - d. Relays shall be IDEC, or an approved equivalent.
3. Provide indicator lights, selector switches, push buttons, meters, etc., as shown on the Contract Drawings, single line diagrams, and as required for correct operation. Mount on the front interior hinged panel of the control enclosure.
4. Push Buttons and Selector Switches: Provide NEMA Type 4/13 for indoor areas and exterior areas with NEMA A300 rated contacts. Provide NEMA Type 4X with hypalon protective boots for corrosive areas. Push buttons shall be standard size (30.5mm mounting hole round, flush head with momentary contacts. Selector switches shall be round with standard operator.
5. Pilot Lights: provide standard full size (30.5mm mounting hole) round, transformer type, NEMA Type 4/13 for indoor and exterior areas or NEMA Type 4X for corrosive areas complete with

color of lens indicated on drawings. Lamps shall be high-density light emitting diodes. Indicating lights shall be push-to-test type.

6. Elapsed Time Meters: Provide synchronous motor driven type, 0- to 99,999.9-hour range, non-resettable type, suitable for semi-flush panel mounting. Provide Yokogawa, 2-1/2-inch Big Look unit; or equal.
7. Control Relays: Provide magnetically held type with NEMA A300 convertible rated contacts and coil voltage, number of poles, and pole arrangement as indicated in the drawings. Relays shall be Allen-Bradley Bulletin 700, Square D Class 8501, type X, General Electric CR120B, or equivalent.
8. Time Delay Relays: Provide solid state magnetically held, with NEMA A300 convertible contacts, and coil voltage, number of poles, pole arrangement, and maximum timing adjustment as indicated on the drawings.
9. Control Power Circuit Breakers: Provide molded case, DIN rail mounted circuit breakers with number of poles and accessories as shown on the drawings. Provide Allen Bradley 1492-GH circuit breakers, GE V-Line Miniature circuit breakers, or equivalent.
10. Panel Nameplates and Identification:
  - a. Identify each item on the control panel with rectangular nameplates.
  - b. Provide nameplates with black letters on white background.
  - c. Minimum letter height is 1/2 Inch for instrument descriptions and 1/4 Inch for instrument tag numbers.
  - d. For all panels which have a panel identification number, provide 2 Inch high white nameplates with 1 Inch high black lettering with panel identification numbers

B. Signal Isolator:

1. Signal isolators shall have complete isolation of input, output and power input. Signal input shall be 4-20 mA into 50 ohms maximum, signal output shall be 4-20 mA into 1000 ohms minimum. Power input shall be 24VDC. Span and zero shall be adjustable. Accuracy shall be plus or minus 0.1 percent of span. Units shall be surface or rack mounted. Signal isolators shall be Moore Industries Model SCT, Rochester Instrument Systems, AGM Electronics TA-4000, or equal.

## 2.04 Fabrication

- A. Fabricate panels with instrument arrangements as shown on the Drawings. Freestanding control panels shall be no less than 36" wide. Control Panels that are part of a motor control center lineup shall be no less than 30" wide.
- B. Prime control panels with rust inhibitive shop applied primer and paint with two coats.
- C. Finish interior of panel with epoxy glass white.
- D. Design and test control enclosures in conformance with UL 508. Enclosure types shall be as follows unless noted otherwise on the Drawings:
  1. Indoor use: NEMA Type 12
  2. Outdoor use: NEMA Type 3R, or NEMA Type 4 as shown
  3. Indoor or outdoor corrosive areas: NEMA Type 4X.
  4. Hazardous Classified Areas: NEMA Type 9

- E. The depth of the control enclosure or compartment shall be a minimum consistent with the maximum depth of the control devices plus the required electrical clearances. In no case shall the depth of the enclosure be less than 8 inches.
- F. Provide back or side panels for mounting of all interior components. Panel finish shall be white enamel.
- G. Enclosure construction shall be minimum 14-gauge steel. Finish shall be white enamel inside and ANSI 61 gray baked enamel outside over phosphatized surface. Equip enclosure door with a pad lockable handle designed for NEMA 12 enclosures, complete with handle, latch, latch rods, and adjustable rod guides. Provide a 1-point latch for 14 inch and less enclosure doors, and a 3-point latch for larger enclosure doors.
- H. Provide a permanent metal data pocket attached to the inside of the enclosure. If space permits, the pocket shall be at least 10-1/2 inches wide and of depth and thickness to accommodate all electrical diagrams.
- I. Provide a foldable metal shelf attached to the inside of the enclosure door. The foldable metal shelf shall be large enough to support a standard laptop computer.
- J. Diagrams
  1. Provide schematic diagrams showing the equipment serial number, the purchaser's drawing number, purchase order number, or similar identification which will indicate the particular equipment to which the diagrams apply. Diagrams shall show all equipment in the electrical system including internal wiring of subassemblies. Diagrams of subassemblies may be furnished on separate sheets. Provide a symbol list identifying symbols used.
  2. Identify each device by a unique number or number-letter combination. Use Contract Drawings numbering scheme, where applicable, to identify each device.
  3. Conductor Identifications: Identify each conductor by a consecutive unique number, letter, or number-letter combination. Each conductor shall have the same identification at all terminals and tie points. Conductors connected to the same terminal or tie point shall have the same identification. Conductor identification shall be as shown below with modifications necessary to provide a unique conductor number for each interconnecting conductor:
    - a. OPNLTB #T #/DPNLTB #T #/C #, where:
      - 1) OPNL is Origination Control Panel, TB # is Terminal Block Number, T # is Terminal Number, DPNL is destination Control Panel, and C # is the three digit conductor sequential number. The following example is shown as a guidance for clarification:
    - b. PMCPTB01T12/PRCPPTTB01T12/100, where:
      - 1) PMCP is Plant Main Control Panel, TB01 is Terminal Block 01, T12 is Terminal Point 12, PRCPPTT is Plant Remote Control Panel PT, TB01 is Terminal Block 01, T12 is Terminal Point 12 and 100 is the conductor unique number.
    - c. Use field device Tag Numbers for connections between two field devices and between a field device and a panel.
  4. The schematic diagrams shall be prepared as shown on the Contract Drawings. The vertical or horizontal lines represent the source of control power. Discrete Inputs/outputs shall be shown as relay contacts, control switch contacts, limit switches, etc. as shown on the Contract Drawings. A group of eight (8) inputs/outputs shall be protected by a fuse as shown. Each Analog Input/output shall be protected a fuse. The fuses shall be integral part of terminal blocks and shall have fuse failure indication LED light.
  5. Where the internal wiring diagrams of subassemblies are furnished on separate sheets, show as a rectangle in the schematic diagram with all external points identified and cross-referenced

to the separate sheets of the control circuit. Show coils and contacts internal to the subassemblies in the rectangle connected to their terminal points.

- a. Exception No. 1: Where relay and electronic circuits are mixed, diagrams may be drawn between horizontal lines which represent the source of control power.
  - b. Exception No. 2: Overload relay contacts may be connected to the right of the coil (common) if the conductors between such contacts and the coils of the magnetic devices do not extend beyond the control enclosure.
6. For clarity, show control device symbols in the order in which the controls are positioned on the diagram.
  7. Use a cross-referencing system for each relay coil so that associated contacts may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, describe the purpose of the contact on the same sheet.
  8. Show spare contacts.
  9. Show limit, pressure, floats, flow, temperature sensitive, and similar switch symbols on the schematic diagram with all source power turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position.
  10. Show contacts of multiple contact devices, e.g., selector switches, on the line of the schematic diagram where they are connected in a circuit. Indicate a mechanical connection between the multiple contacts by a dotted line or arrow. This does not apply to control relays, starters, or contactors.
  11. Additional charts or diagrams may be used to indicate the position of multiple contact devices such as drum, cam, and selector switches.
  12. Show the purpose or function of all switches adjacent to the symbols.
  13. Show tag name and device identification numbers above devices, relay coils, relay contact, etc.
  14. Describe the purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram adjacent to their respective symbols. Show the number of positions of the solenoid valve adjacent to the valve solenoid symbol.
  15. Show values of capacitors and resistors on the diagram.
  16. Descriptive terms for command and status functions shall be in the present or past tense. For example, Raise Transfer-Transfer Raised; Advance Transfer-Transfer Advanced. Do not use terms such as "Transfer Up."
  17. Show field wiring as dashed lines.
  18. The panel front and internal layouts shall show the general physical arrangement of all components on the control panel. Identify devices with the same marking as used on the schematic diagram. Spare panel space shall be dimensioned.

#### K. Free-Standing Panels

1. Minimum construction thicknesses:
  - a. Front panel, sub-panel, or front door with cutouts: 0.123 IN.
  - b. Top, sides, back, filler plates and side or doors with no cutouts: Minimum thickness per, NEMA ICS 6, Tables 3-8,9.
2. Welded construction
3. Completely enclosed, self-supporting, and gasketed dust-tight

4. Edges turned back minimum of 2 IN.
5. Seams and corners welded and ground smooth to touch and smooth in visual appearance.
6. Arrange control panel faces continuous and flush with face of adjacent electrical motor control centers.
7. Provide filler panels where necessary to close gaps between panels or back of panel and wall. Provide full length flush pan doors.
8. Provide full length piano hinges rated for 1.5 times door plus instrument weight.
9. Furnish doors with keyed alike locking handles and three point catch.
10. Provide appropriate conduit, wiring, and instrument openings in accordance with best panel design.
11. After cutouts have been made, finish opening edges to smooth and true surface condition.
12. Provide each panel with lifting eyebolts. Furnish hot-dipped galvanized steel base channels.
13. Slotted bolt holes in base, 1 ½ long for field adjustment

L. Wall Mounted Panels or Motor Control Center mounted Panels:

1. Minimum construction thicknesses:
  - a. Front panel, sub-panel or door with cutouts:
    - 1) Width or height not exceeding 42 IN: 0.093 IN.
    - 2) Width or height exceeding 42 IN: 0.123 IN.
2. Side, top, back and doors without cutouts: minimum thickness per NEMA ICS 6, Tables 3-8, 9.
3. Seams continuously welded and ground smooth.
4. Body stiffeners for extra rigidity if either height or width exceeds 28 IN
5. Rolled lip around all sides of enclosure door opening.
6. Gasketed dust tight
7. Three-point latching mechanism operated by oil tight key-locking handle
8. Key doors alike
9. After cutouts have been made, finish opening edges to smooth and true surface condition.
10. Front full opening door.
11. Brackets for wall mounting

M. Panel Front Construction

1. Welded construction
2. Edges turned and ground smooth to touch and visual appearance.
3. At joints where panel face meets side walls, provide dustproof sponge rubber gasket entire height and face.
4. Use full length piano hinges rated for 1.5 times door weight for panel access door.
5. Equip doors with locking devices and handle and three point catches.
6. Finish all instrument cutouts smooth and true.

N. Panel Wiring and Piping

1. Factory wire the panels to identified terminal blocks equipped with screw type lugs.
2. Install all wiring without splicing in factory in raceways:
  - a. Size raceways per the requirements of NEC Article 373
  - b. Raceways shall have removable covers.
3. Wire bending space shall be in accordance with Tables 307B, C in NEMA ICS 6.
4. Keep AC power lines separate from low-level DC lines, I/O power supply cables, and all I/O rack interconnect cables.
5. Keep AC signal wires separate from DC signal wires.
6. When I/O wiring must cross AC power wiring, it shall only do so at right angles.
7. Arrange circuits on terminal blocks plus any spare conductors on adjacent terminals.
8. Provide necessary power supplies for control equipment.
9. Equip each panel with a main thermal magnetic circuit breaker. Limit load to maximum of 80 percent of circuit breaker rating.
10. Provide all necessary stabilizing voltage transformers, balancing potentiometers and rectifiers as necessary for specific instrument requirements.
11. Assure each panel mounted device is bonded or otherwise grounded to panel or panel grounding system by means of locknuts or pressure mounting methods.
  - a. Equip panel with grounding terminals.
12. Arrange wiring with sufficient clearance for all leads.
13. Wiring to subpanels or rotary switches shall be individually bundled and installed with a "flexible loop" of sufficient length to permit the component to be removed from panel for maintenance without disconnecting wiring.
14. Identify all wires with plastic sleeve type wire markers at each end. Markers shall:
  - a. Identify circuit numbers.
  - b. Identify function and polarity.
15. Provide all wiring according to color code as follows:

<u>Color of Insulation</u>	<u>120 V, 60 HZ AC Service</u>	<u>Low Voltage, DC Service</u>
Black	Phase Conductor	Negative (Analog – transmission)
Red		Positive (Analog transmission and control power)
White	Neutral	Positive (Analog)
Brown	Annunciator Common	Annunciator Common
Orange	Annunciator Signal	Annunciator Signal
Gray	Interconnections	
Green	Ground	

- a. For intrinsically safe instruments, provide uniform and compatible additional color scheme.

- b. Label all wiring per the wiring scheme specified in these specifications.

#### 16. Termination Requirements

- a. Terminal block markings, mechanical characteristics and electrical characteristics shall be in accordance with NEMA ICS 4. Label per these specifications.
- b. Terminals shall facilitate wire sizes as follows:
  - 1) 120 V AC applications: Wire size 10 AWG and smaller.
  - 2) Other: Wire size 14 AWG and smaller.
- c. Provide terminal blocks with continuous marking strip.
- d. Tag each I/O terminal to indicate tag number of the connected device.
- e. Provide terminals for individual termination of each conductor.
- f. Provide 20 percent excess terminals for future expansion.
- g. Terminal blocks to be din rail mount type.
- h. All terminal points for analog signals shall be fused.
- i. All terminal points for the DIs/DOs requiring fusing shall be fused.
- j. Identify wire terminations with a number to correspond with the schematic diagrams. Identification tags shall be preprinted white heat shrinkable tubing, Raychem Thermofit TMS, or equivalent.
- k. Plainly and permanently identify control and other devices using the same identification as shown on the schematic diagrams. Show identification for devices inside the enclosure on the plate adjacent to, not on, the device.
  - 1) Exception No. 1: Where the size or location of the devices make individual identification impractical, such as on electronic assemblies, use group identification.
  - 2) Exception No. 2: Where panel layouts do not permit mounting identification plates adjacent to components, such as relays, place the permanent relay identification on the relay where it is plainly visible, and provide a second identification on the top of the panel wireway cover directly below the relay. Identify the wireway covers to show their proper location.
- l. Identification plates for devices mounted inside and outside the control enclosure shall be one of the following:
  - 1) Laminated phenolic for engraving stock; a minimum of 0.062 inch thick. Hold plates in place with metallic drive screws of the equivalent. Use permanent adhesives for attaching nameplates to wireway covers.
  - 2) Non-corrodible metal; a minimum of 0.031 inch thick for engraving stock of 0.012 inch thick for embossing stock. Hold plates in place with metallic drive screws.
- m. All spare I/O shall be wired to terminal blocks.

#### O. Panel Lighting and Power

- 1. Receptacles - As specified herein, unless otherwise shown on the Contract Drawings:
  - a. Panels less than 4 FT long:
    - 1) One electrical outlet.
    - 2) One fluorescent light fixture with door activated switch and separate circuit breakers.
  - b. Panels or panel faces greater than 4 FT long:

- 1) One electrical outlet per 6 FT of length
- 2) Continuous fluorescent lighting strip with door activated switches and separate circuit breakers.

P. Telemetry Radio Communication:

1. Relocate existing Radio Modem from existing Control Panel to new Control Panel. Provide new mounting components and associated parts as required.

Q. Environmental Controls

1. Where heating from control devices results in a temperature rise which is detrimental to the contained equipment or its operation, provide louvers or forced air ventilation with air filters. When forced air ventilation is required, the cabinets shall be pressurized. Air filters shall be of commercially available types and sizes.
2. Over-temperature switches shall be utilized to provide cooling if required to maintain operating temperatures within the manufacturer's specified range.
3. Air conditioning applications shall include means of preventing moisture condensation.
4. For panels or control cabinets located outside, or in area classification requiring a NEMA 4 or 4X rating:
  - a. Provide printed circuit boards with "Humiseal" conformal coating, covering entire components on both side of board except not covering adjustable components.
  - b. Furnish gold plated edge connectors on circuit board and socket contacts.
  - c. Install thermostatically controlled condensation protection heaters or 10 CU IN desiccant packs in enclosures housing electronic equipment.
    - 1) Provide one pack for each 10 CU FT of panel capacity

## **PART 3 - EXECUTION**

### **3.01 Installation**

- A. Install control panel in building as detailed on the Drawings.

### **3.02 Field Quality Control**

A. Factory Tests

1. Inspect and test control panel for correct operation. Test each circuit for continuity, short circuits, and fault grounds.
2. Control Panel Factory Tests shall be at the presence of the Engineer. Notify the Engineer at least one week prior to the Factory Tests.
3. Provide a descriptive Test Plan for review and approval prior to the Factory Tests. Identify the test procedure and equipment required for the tests.

B. Site Tests

1. Submit a Test Plan for approval prior to the Site Tests. Clearly identify the test procedures and equipment intended for the tests.
2. Calibrate all field instrumentation and devices requiring calibration and record the data on specified forms prior to the tests.

3. Test control panels with all field wiring connected. Test each loop for proper operation. Set all adjustable set points and time delays as required. Check operation of control panels and field devices and perform required adjustments for correct operation.
4. Coordinate all tests with the Owner and Engineer prior to the tests.
5. Perform all tests at the presence of Engineer or his representative

**\*\*END OF SECTION\*\***

**SECTION 17506  
EXTENDED WARRANTY & MAINTENANCE**

**PART 1 - GENERAL**

**1.01 Summary:**

A. Scope: The requirements for extended warranties and maintenance for equipment that is placed into operation prior to final completion.

**1.02 References**

- A. General: Refer to equipment manufacturers' approved and certified documentations for the Extended Warranty and Maintenance (EW&M) agreements to provide EW&M for equipment installed.
- B. Related Sections: Refer to General Requirements of Divisions "0" and "1" for the pertinent references addressing the EW&M requirements.

**1.03 Submittals**

- A. General: Submittals shall be provided for all EW&M agreements for review and approval.
- B. Related Sections: Refer to General Requirements of Divisions "0" and "1" and Divisions "16" and "17" for submittal requirements for the EW&M.
- C. The Contractor shall include documentation in the submittal that EW&M's have been obtained for all equipment. The documentation shall include a "TABLE" listing all equipment tag numbers, manufacturer's contact information, EW&M effective date, EW&M expiration date, renewal requirements, and a comments column for general notes as specified below:

<u>Equipment Tag</u>	<u>Manufacturer Contact Info.</u>	<u>EW&amp;M Effective Date</u>	<u>EW&amp;M Expiration Date</u>	<u>Renewal Requirements</u>	<u>Comments</u>
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**1.04 Quality Assurance**

- A. Extended Warranty and Maintenance Requirements
  - 1. As a minimum, provide the EW&M for all hardware supplied under this CONTRACT for a period of one year after the manufacturers' Standard Warranty (SW) has expired. The SW shall become effective after the Final Commissioning and Acceptance (FCA).
  - 2. All failed parts during the EW&M period shall be repaired or replaced without any cost to the OWNER including labor, material, and shipping charges.
  - 3. Warrant all software, including layered software, supplied by the CONTRACTOR against any defect for a period of two (2) years after the FCA. Correct any defect in the software, without charge, during the warranty period. If necessary, make the corrections and test the revised software on site without any charges to the OWNER during this period

### **1.05 Maintenance**

- A. Properly maintain operating equipment throughout the course of the EW&M without any charges to the Owner.
- B. Perform preventive maintenance in accordance with the manufacturer's recommendations. Include inspection, testing and calibration, cleaning, lubricating, and replacement of worn or defective parts.
- C. Keep maintenance service records with the equipment and make them immediately available to the OWNER during the course of the EW&M.
- D. Provide maintenance contracts that are renegotiable and expandable yearly, at the OWNER's option, for a minimum period of ten (10) years.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

**\*\*END OF SECTION\*\***

## **SECTION 17510 FACTORY ACCEPTANCE TESTS**

### **PART 1 - GENERAL**

#### **1.01 Summary:**

- A. Scope: This section describes the minimum requirements for Factory Acceptance Test (FAT).
- B. Conduct a formal FAT prior to shipment of equipment to the project site. The purpose of the FAT is to verify compliance with the design specifications and correct deficiencies at the Contractor's facility to prevent extensive field tests.
- C. The Contractor shall prepare a FAT Plan (FATP) for review and approval by the Engineer prior to scheduling the FAT. The Contractor shall dry run all tests prior to the FAT to expedite the process. All costs including test equipment, hardware and software of the FAT shall be included in the Contractor's original bid price.

#### **1.02 System Description**

- A. The purpose of this test is to qualify each system, insofar as practical, as having met the functional, performance, and interface requirements. Verify the performance and functional integrity of the individual subsystems, including active interfaces between subsystems, and demonstrate the operation of the subsystems on an integrated system basis.
- B. Supervise and assist in the tests. The Owner/Engineer shall be notified to actively participate in the tests.
- C. Application software developed by the Control System Integrator will be installed on the system during FAT. The Control System Integrator may add, modify and delete application software during testing to simulate normal operating conditions.
- D. The Owner/Engineer reserves the right to test any specified function, whether or not explicitly stated in the test submittal.
- E. Provide knowledgeable personnel capable of explaining procedures and test results to the understanding and satisfaction of the Owner/Engineer.
- F. Meet the following criteria prior to the start of the tests:
  - 1. Complete submittals and resolve disputes.
  - 2. Have approved test procedure.
  - 3. Set a test date that is agreeable to all.

#### **1.03 Submittals**

- A. Test Plan Submittals
  - 1. Prepare and submit FAT procedures to the Owner/Engineer for approval at least thirty (30) days prior to the scheduled test date.
  - 2. Notify the Owner/Engineer at least fifteen (15) days prior to the scheduled start of the FAT. All Control Panels and Motor Control Center equipment shall be, in the opinion of the Contractor, ready for the formal FAT prior to scheduling.
  - 3. Submit dry run test results at least three (3) days prior to the scheduled start of the FAT.
  - 4. Submit completed FAT procedures document with signatures, dates, test results, and notes.
    - a. Factory Acceptance Test Procedures Document shall:

- 1) Include individual ID number, name, description and date of each test,
  - 2) List the logical step by step procedure with expected response at each step and provide space for recording results,
  - 3) Provide space for approval for each test,
  - 4) Provide space for hand written comments,
  - 5) Include checkpoints at critical points in logic,
  - 6) Provide minimal reference to other documents,
  - 7) Be written such that OWNER personnel can use it during site testing,
  - 8) And describe steps necessary to simulate inputs required by the test.
- b. Include the following in the FAT submittal:
- 1) Location of FAT,
  - 2) FAT procedures,
  - 3) A schedule of daily activities indicating that the FAT will be completed in the allotted time,
  - 4) Configuration, cabling and wiring diagrams locating and identifying all equipment used for the test,
  - 5) A hardware inventory including manufacturers, model numbers, serial numbers, and item descriptions,
  - 6) A software inventory organized by computer on which it is installed including Contractor's names, software name and version, and
  - 7) A list of documentation that will be on hand during testing including manufacturers' or Contractor's names, document descriptions and document numbers

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.01 Installation**

#### **A. Authorization to Ship**

1. The Owner/Engineer will issue the Authorization to Ship (ATS) after successful completion of the FAT, and resolution of deficiencies. The ATS will list all known system deficiencies, and what modifications are required to allow shipment.
2. The Contractor shall agree to the conditions and schedule in the ATS and acknowledge this agreement with an authorized signature before the ATS will be issued.
3. No equipment will be accepted at the Owner's sites until an ATS has been issued.

#### **B. Owner/Engineer Involvement**

1. The Owner/Engineer shall witness all testing activities.

#### **C. Expenses**

1. Pay costs for (3) representatives from the Owner and (3) representatives from the Engineer to attend each test and retest if a test fails. Provide the following:

- a. Meals
- b. Accommodations (if the Factory Test Site is more than 150 miles from the project site)

D. Testing Aids and Equipment

1. Provide the following documentation:
  - a. One copy of submittals applicable to the equipment to be tested
  - b. One copy of the Drawings and Specifications together with addenda and change orders
  - c. One master copy of the test procedure
  - d. A complete inventory of the equipment to be tested and any special test equipment including make, model and serial number
2. Provide the following support facilities:
  - a. Meeting room access
  - b. Copy machine access
  - c. Telephone for local and long distance service
  - d. FAX machine access
  - e. Internet access
3. Provide the following test equipment:
  - a. Off line diagnostic and test programs.
  - b. Maintenance and test equipment including, but not limited to, serial data analyzer, electrician tool set, electrical continuity tester, analog loop amp meter.

E. Retest

1. If a test, or portion of a test, defined in the FAT procedures fails and needs to be rescheduled, pay expenses of Owner/Engineer personnel for retesting.

**3.02 Field Quality Control**

- A. Conduct the FAT in accordance with plan and procedures documented in the submittal for this section.
- B. Testing shall be conducted Monday through Friday for no more than 8 hours per day. Testing at other times requires the approval of the Owner/Engineer.
- C. Provide simulation of the PLC network to duplicate loading to the SCADA system.
- D. Programmable Logic Controller (PLC) Testing
  1. Provide written proof of coordination of data transfers between the Pump Station PLC and the Telemetry System
  2. Download Vendor, Plant Control System Integrator supplied control strategies and execute. Test functionality and performance of all strategies.
  3. Provide hardware and software required for simultaneously simulating all the inputs/outputs.
  4. Perform the following functional tests:
    - a. Demonstrate proper operation of I/Os.
    - b. Demonstrate that analog points are within the specified accuracy when the inputs/outputs are at 25, 50, 75, and 100 percent of full scale. Demonstrate proper operation of analog inputs with the required signal levels.

- c. Test operation under power failure conditions.
- d. Demonstrate that the control strategies are functioning as specified.
- e. Conduct other tests as required and directed by the Engineer.

#### E. System Factory Acceptance Test

1. The System Factory Acceptance Test includes, but is not limited to, the tests described in the following subsections.
  - a. Test each hardware component individually.
  - b. Verify inventory, model numbers and serial numbers.
  - c. Run standard hardware diagnostic programs, plus all special diagnostic programs used by the Contractor to demonstrate that the hardware development is complete.
  - d. Test include, but are not limited to, the following:
    - 1) Verify the correct functional operation of hardware and software.
    - 2) Verify scanning and data acquisition of all data points from the PLC.
    - 3) Verify control operations to ensure that they result in the correct communication protocol and operation.
    - 4) Test operator interface functions.
    - 5) Verify on line programming of the PLC.
    - 6) Verify the operation of historical data storage, displays, and trends
    - 7) Test the behavior of the System in various failure modes, including I/O point failure, I/O module failure, communication channel failure, and peripheral and hardware component failures. Switch power off and on to hardware components. Reboot computers.
    - 8) Demonstrate that the spare capacity and expansion requirements have been met.
    - 9) Test on line display generation and modification functions.
    - 10) Verify that the System meets all the performance requirements, under simulated loading.
    - 11) Test custom software written specifically for this project.
    - 12) Test control strategy generation.
    - 13) Perform backup and reload of operating system, SCADA software, historical data, and applications.
    - 14) Test control strategy generation.
    - 15) Demonstrate the modification of logs, displays and database.
    - 16) Test alarm conditions for analog and discrete points
    - 17) Conduct other tests as instructed by the Engineer.

### 3.03 Adjusting / Cleaning / Protection

#### A. Correction of Deficiencies

1. Document all discrepancies found during the Factory Acceptance Test and maintain in a record file. Describe subsequent corrections. The Owner/Engineer will verify proper operation.

2. Faulty or incorrect operation of major functions (i.e., major discrepancies) may be cause for suspension or restarting of the entire test, pending the correction of the problem. Minor discrepancies noted may be corrected and retested.
3. The system will not be shipped until the successful completion of the FAT certified by the Owner/Engineer. Delay in shipment of the system due to failure to pass FAT will not be considered an unavoidable delay and justification for later delivery.
4. System performance testing will not be started until approved by the Owner/Engineer

**\*\*END OF SECTION\*\***

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## **SECTION 17512 SITE ACCEPTANCE TESTS**

### **PART 1 - GENERAL**

#### **1.01 Summary:**

- A. Scope: This section describes the requirements for the Site Acceptance Testing (SAT) at the WWTF and shall encompass improvements as specified in these specifications.
- B. Conduct a formal SAT prior to final commissioning of the project. The purpose of the SAT is to verify operation of the Instrumentation and Control System (ICS) to ensure that the ICS perform in compliance with the design specifications and control strategies and correct deficiencies.
- C. The Contractor shall prepare a SAT Plan (SATP) for review and approval by the Owner/Engineer prior to scheduling the SAT. The Contractor shall correct any deficiencies from the field tests performed prior to the SAT to expedite the SAT process. All costs including test equipment, hardware and software of the SAT shall be included in the Contractor's original bid priced.

#### **1.02 Submittals**

- A. Submittals shall be in accordance with Special Provisions, Section 17010 and requirements of this Section. All submittals of this Section shall be the responsibility of the Contractor.
- B. Submit a SAT Plan (SATP) at least 30 days prior to the start of testing for review and approval by the Owner/Engineer. The SATP shall include all procedures, equipment, detailed schedule, Standards, personnel or subcontractors responsible for testing and Test Forms necessary for a complete SAT.
- C. Within 15 days following completion of the site tests, submit the SAT report to the Engineer.
- D. Include the following information in the submittal.
  - 1. Calibration and testing information for all instruments throughout the Pump Station including the existing and new instruments
  - 2. All instrument loop checkout schedule
  - 3. Loop checkout procedures including sign-off forms
  - 4. Loop tuning procedures
  - 5. Control strategy test schedule arranged by unit process
  - 6. Control strategy test procedures and sign off forms
  - 7. Procedures and sign-off forms for all other tests specified

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.01 Field Quality Control**

- A. Perform field-testing to verify the automation operations associated with the control systems and manual operations with the PLC systems disabled. Perform field-testing sequentially and organize by unit process within each process area. Field tests shall include:
  - 1. Power failure tests including utility and UPS,

2. Control loop tests,
  3. Control loop tuning,
  4. Control strategy tests,
  5. Integrated system test,
  6. Manual operation tests
- B. The Contractor shall be responsible for the following tests which shall be completed prior to joint Contractor - Engineer loop and end-to-end tests:
1. Calibration of all instruments and final control elements, except those not provided by the Contractor
  2. All field wiring tests, including continuity, insulation resistance, and others specified elsewhere.
  3. Basic analog and discrete loop checkout of hardwired circuits, including:
    - a. Verification that each field instrument is connected to the correct, tagged wires at each control panel
    - b. Verification at each control panel that every field signal has correct voltage polarity
    - c. Verification that the local panels and packaged systems supplied by the Contractor are completely and properly installed, and that all associated logic works properly
- C. After the completion of instrument calibration as applicable, but prior to Integrated System Testing, perform the loop and end-to-end tests. To the extent practical, begin testing promptly after installation of each major subsystem. A subsystem is an integrated, fully operational subset of the control system and includes:
1. Programmable logic controller (PLC)
  2. Communications equipment required for operation of the subsystem
  3. Field instruments, panels, termination cabinets, control devices and related interconnections provided for the plant area
  4. Each and every control and instrumentation circuit modified or replaced by the Contractor shall be tested
  5. These tests shall include all signals that are connected to the PLCs through digital networks. The test shall also include all hardwired input/output loops
- D. Meet the following conditions prior to the start of any testing:
1. Correct deficiencies noted during the factory testing
  2. Have documentation on-site pertinent to the part of the system being tested
  3. Have on-site, labeled, and properly stored spare parts, expendables and test equipment pertinent to the part of the system being tested
  4. Have Owner/Engineer approved test schedules and test procedures
- E. Provide written notice 48 hours in advance of intent to commence the SAT procedures.
1. Clearly identify sections of the SAT procedure to be conducted
  2. Failure to properly notify the Owner of anticipated testing activities would not be considered an unavoidable delay or justification for compensation
  3. Process operational constraints, personnel availability, and other's work are valid reasons for re-scheduling testing.

- F. Coordinate all field-testing through the Owner on a daily basis
1. The Owner may redirect testing from one unit process to another. Pre-negotiated price shall include, as a minimum, redirection of testing as follows:
    - a. The redirection does not cause more than a two-hour interruption to the testing to move test equipment and test personnel to the new unit process.
    - b. There is no change in the amount of test equipment or personnel requirements.
    - c. The redirection is not arbitrary. Process operational constraints, personnel availability, and other's work are valid reasons for redirection.
    - d. The redirection does not occur more than once in any workday subsequent to the daily scheduling meeting.
    - e. Perform no testing that may affect plant operation without Owner concurrence.
- G. Perform tests by following the operation and maintenance manuals word-for-word unless approved otherwise by the Owner/Engineer. Lack of complete, detailed manuals will be a cause for declaring the test to have failed regardless of the actual test results.
- H. Make available for Owner's use loops and control strategies that have been verified to operate properly immediately subsequent to conclusion of the respective test.
- I. The Owner/Engineer will witness all testing activities.
- J. Loop Tests
1. The Contractor shall be responsible for loop tests. The Contractor shall provide full-time staff to support and conduct these tests. The Contractor shall operate all field equipment, inject simulated field signals, record results observed in the field, check the proper operation of field equipment, and promptly correct any deficiencies or problems found with the Contractor-supplied equipment or work. The Contractor shall be responsible for performing all testing activities including test plans, test forms, test documentation, test reporting, and other test activities specified below.
  2. Check each loop from the end element to the respective control display. Include instruments, control devices, panels, termination cabinets, input/output cards and other devices in the loop to ensure proper operation and linkage to control station displays.
    - a. Analog inputs shall be tested at a 0 percent, 25 percent, 50 percent, 75 percent and 100 percent of scale for proper receipt within tolerances.
    - b. Discrete inputs shall be tested to verify proper state when the field device is switched between states.
    - c. Discrete outputs shall be tested to verify equipment respond properly (start, stop, etc.).
    - d. Verify the proper operation of each discrete control loop to insure the proper operation of motors, hand switches, interlocks, solenoid valves, other auxiliary devices, status lights, operator interfaces, and alarms.
    - e. Test operation of the final control element through panels and through control stations for new or modified equipment. If a final control element is out of service or not released by the Owner for testing simulate operation at the final control element location.
    - f. Each analog network shall be tested by applying simulated analog or discrete inputs to the first element of an analog network. For networks that incorporate analog elements, simulated sensor inputs corresponding to 0, 25, 75, and 100% of span shall be applied, and the resulting element outputs monitored to verify compliance to calculated root-mean-square-summation accuracy tolerance requirements.



- a. Sequences
  - b. Alternate control modes
  - c. Dynamic gain adjustments
  - d. Contingency responses to device failures, where possible
  - e. Display and keyboard interaction
  - f. Messages
3. Prior to use on the process equipment, compare strategies with approved submittals to verify that as-built linkages and control logics agree with the documentation. Note and correct discrepancies.
  4. Test as much of the logic as possible using process equipment.
  5. Document strategy tests and submit to the Owner/Engineer. Include:
    - a. Date
    - b. Strategy identification
    - c. Tests performed
    - d. Logics which could not be tested and reasons
    - e. Copies of messages, displays and trends which verify operation
    - f. Problem description, if any
    - g. Signature of tester and date
    - h. Signature of Owner/Engineer and date
  6. Annotate changes made during testing on the documentation to reflect final as-built conditions.

#### M. Integrated System Testing

1. Integrated system testing shall be the responsibility of the Contractor
2. The Owner/Engineer will monitor and participate in the test
3. Perform integrated system testing to verify the operation and performance of the complete, integrated control system
4. Begin integrated system testing after all other field tests have been completed
5. Provide full-time, on-site assistance during the business days and within four hours after call in for the test duration
6. Demonstrate the availability of 99.0 percent or better for the system. Percent availability is equal to:
 
$$\frac{(\text{Test Duration} - \text{Downtime})}{\text{Test Duration}} \times 100$$
7. The system is down if:
  - a. An on-line PLC is not polled
  - b. Operator commands cannot be carried out to the PLC
  - c. Failure of equipment due to improper operation by the Owner or failures of equipment not supplied under this Contract shall not be counted as downtime
  - d. Failover to a backup device shall not be counted as downtime provided the backup device promptly assumes proper operation.

8. With coordination with the Owner/Engineer operate the entire pump station processes for 10 consecutive days, 24 hours per day prior to full acceptance by the Owner. If deficiencies are found, the Contractor shall correct the deficiencies and retest the affected systems until all deficiencies are proved to be corrected. All deficiencies shall be promptly corrected within 24 hours of notice by the Owner/Engineer. The retest shall be started as soon as possible or within not more than two (2) days. Testing shall continue until ten consecutive days of proper operation can be demonstrated. Commissioning shall take place after the entire Plant processes are proved to operate properly as determined by the Owner/Engineer

**\*\*END OF SECTION\*\***